PHYSICAL OCEANOGRAPHY OF THE RICHIBUCTO ESTUARY (NEW BRUNSWICK): FALL CONDITIONS IN 1996

St-Hilaire, A., A.D. Boghen, S.C. Courtenay, A.R. LeBlanc and M. Maillet

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Physical Oceanography of the Richibucto Estuary (New Brunswick): Fall conditions in 1996

by

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ABSTRACT

St-Hilaire, A., A.D. Boghen, S.C. Courtenay, A.R. LeBlanc, and M. Maillet. 2001. Physical oceanography of the Richibucto Estuary (New Brunswick) : Fall conditions in 1996. Can. Tech. Rep. Fish. Aquat. Sci. 2360: vii + 122 p.

A survey of physical oceanographic measurements was undertaken in the fall of 1996 in the Richibucto Estuary (New Brunswick), as part of the Richibucto Environment and Resource Enhancement Project (REREP). Forty-five stations were sampled between 9 September 1996 and 24 October 1996, using a current meter profiler equipped with temperature and conductivity sensors. Stations sampled were distributed between the Richibucto Dunes and Brown's Yard in the main Richibucto River, in the St-Charles River, upstream of the Highway 11 crossing, and in Baie du Village and Richibucto Harbour.

Water temperature varied between 6.5°C and 19°C during the survey period. Salinity varied between 0 and 26 Practical Salinity Units (PSU) along the estuary. Isohaline plots showed weak (< 0.25 PSU/m) vertical stratification in the lower portion of the estuary. Salt water was shown to migrate as far upriver as 37 km upstream from the Richibucto Dunes, to Brown's Yard.

Isovels showed some strong (i.e. > 1 m/s) near-surface currents in some areas. Tidal inversion of current direction was observed as far as 18 km upstream of the Richibucto Dunes, near Big Cove.

RÉSUMÉ

St-Hilaire, A., A.D. Boghen, S.C. Courtenay, A.R. LeBlanc and M. Maillet. 2001. Physical oceanography of the Richibucto Estuary (New Brunswick): Fall conditions in 1996. Can. Tech. Rep. Fish. Aquat. Sci. 2360: vii + 122 p.

Une campagne de mesure de variables océanographiques a été entreprise dans l'estuaire de la rivière Richibouctou durant l'automne 1996. Cette campagne a été exécutée dans le cadre du Projet Environnemental et de Mise en Valeur des Ressources de Richibouctou (PEMVRR). Quarante-cinq stations ont été échantillonnées entre le 9 septembre et le 24 octobre 1996, à l'aide d'un courantomètre permettant de faire des profils verticaux. Cet appareil était aussi muni de capteurs de température et de conductivité. Les stations échantillonnées étaient réparties entre les dunes de Richibouctou, jusqu'à Browns Yard dans la rivière Richibouctou, dans la rivière St-Charles jusqu'à la traverse de la route 11, dans le havre de Richibouctou et dans la Baie du Village.

La température de l'eau a varié entre 6.5°C et 19°C durant la campagne de mesures. La salinité a varié entre 0 et 26 Unités de Salinité Pratique (USP) dans l'estuaire. Les courbes isohalines ont démontré qu'il y avait peu de stratification verticale (< 0.25 USP/m) dans la portion de l'estuaire plus en aval. La présence d'eau salée (ou saumâtre) a été mesurée jusqu'à 37 km en amont des dunes du Richibouctou, en amont de Brown's Yard.

Les courbes d'isovélocité ont démontré qu'il existe des courants forts (> 1 m/s) près de la surface à certains endroits. L'inversion de la direction des courants, imputable à la marée, a été observée jusqu'à 18 km en amont des dunes de Richibouctou, dans la région de Big Cove.

1.0 INTRODUCTION

The Richibucto Environment and Resource Enhancement Project (REREP) was launched in 1995 by the Environmental Science Research Centre of the Université de Moncton, in partnership with the local communities and various government agencies, including Fisheries and Oceans Canada. The REREP is a multi-phase, multi-disciplinary investigation. The main objective of the program is to maximize long-term social, recreational and economic benefits from existing and potential estuarine resources for the residents of the area.

One of the objectives of Phase 1 (1996-1999) of this project was to collect basic oceanographic data to enhance our understanding of the circulation patterns, salt wedge migration and mixing which occur in the estuary (Boghen et al. 1996). Field measurements began in the fall of 1995, but were limited to the Northwest Branch, lower Richibucto Estuary (i.e. below the confluence of the St-Nicholas River) and Richibucto Harbour (between the Dunes and the town of Richibucto; Figure 1). CTD (Conductivity, Temperature, Depth) casts taken showed weak (typically < 0.2 Practical Salinity Units/m) vertical stratification but significant (0.4 to 1 PSU/km) longitudinal (upstream-downstream) stratification (St-Hilaire et al. 1997).

This report presents an analysis of the data gathered during the second oceanographic field season, which occurred between 9 September and 24 October 1996. The objective of the field survey was to investigate the upstream extent of the salt wedge in the Richibucto and St-Charles Estuaries, as well as to provide descriptive information on mixing and water movement.

2.0 METHODS

2.1 Study site

The Richibucto Estuary is a coastal plain watershed located in southeastern New Brunswick, with a drainage basin covering 1088.5 km^2 (Montreal Engineering Company 1969). The shallow bay is fed mostly by several rivers, including the

main Richibucto River, the St-Nicholas River and the St-Charles River via the Northwest Branch (Figure 1). The mean annual freshwater discharge into the estuary is 26.0 m^3/s. The mean monthly discharge in the fall (September-November) is usually less than or equal to the mean annual flow (Gregory et al. 1993). Richibucto Bay (also known as Richibucto Harbour) is shallow, with depths seldom exceeding 1 m, except for a 150 m wide channel where depths reach a maximum of 12 m. The bay is separated from Northumberland Strait by a system of sand dunes (Figure 1). Tides in the area are mixed, mostly semi-diurnal and have a range seldom exceeding 0.6 m.

2.2 Current meter profiling

Forty-five stations were sampled between 9 September 1996 and 24 October 1996 (Figure 1), using an Interocean-S4P current meter (Interocean, 1987). The current meter is equipped with temperature, conductivity and pressure sensors. It also has velocity sensors providing current speed and an internal compass for current direction (Table 1). At each station (Table 2), the boat was anchored and the current meter was lowered slowly (0.2 m/s) in the water column from the surface to 0.5 m above the bottom. To minimize the impact of fluctuating current speed and direction, the meter was kept at 2 to 3 selected depths (i.e. 0.5 m below the surface, 0.5 m above the bottom and in the middle of the water column where possible) for a period of at least 1 minute. Measurements were taken every half second and a 10 second average was recorded internally by the meter. All data gathered at selected depths were averaged. Stations were usually located near the middle of the channel, except in Richibucto Harbour and Baie du Village, where transects were surveyed.

Salinity was calculated from conductivity, temperature and pressure (depth) using the standard UNESCO algorithm for Practical Salinity Units (PSU, Foffonof and Millard 1983) by the computer software provided with the Interocean S4P current meter (Interocean, 1987). Densities (in kg/m^3) were also calculated by the same software using pressure, conductivity and temperature data. Salinity and temperature data were also recorded near the surface and bottom at all stations, using a YSI salinity meter (Table 3) for cross reference with the current meter. There was good generally good agreement between the two salinity and

temperature sensors. Temperature differences between the S4P and the YSI were < 1°C, while salinity differences usually did not exceed 2 PSU. It should be noted that salinity measurements are harder to compare because they use two different scales (PSU and ‰). Also, the YSI is not equipped with a pressure sensor. Depths were measured visually on the meter line, as it was lowered.

2.3 Isohaline curves

Data retrieved from the current meter were divided into up and down casts. The down casts were used to plot isohaline curves. Such curves provide a spatial overview of the stratification in the estuary. Close horizontal lines are indicative of a strong vertical gradient, while vertical lines show a well-mixed water column with longitudinal (upstream-downstream) stratification. Isohalines were calculated using a matrix of distance along the main channel from a known point (x-axis, from River km 0, located near the northeastern limit of the Richibucto Dune; Figure 1), depth (y-axis) and salinity (z-axis). The data were introduced in a statistical software package (Systat 5.0) and contour lines were plotted using a Distance Weighted Least Square algorithm (DWLS). The maximum depths recorded by the current meter at each station for a given date were used to plot the bottom contour. Linear interpolation between points was used to provide the idealized bottom on each isohaline figure (shaded area, Figures 2-13).

2.4 Currents

The Interocean S4P provides current vectors with magnitude in cm/s and direction provided by a compass in degrees. Since typical two-dimensional estuarine models usually use the component of the current parallel to the main channel to describe the upstream-downstream movement of water, the current vectors were broken down in 2 components, referred to as the U and V. The U component was taken as being parallel to the main channel component, positive in the downstream direction. The V component was defined as the component perpendicular to the main channel, positive towards the "True Left Bank" (left bank when looking downstream). Isovels were built using the U component of the current vectors measured during each survey.

3.0 RESULTS

3.1 Temperature

Temperatures varied between 6.5°C and 19°C during the survey period (Table 3, Appendix A). In most instances, the water column was isothermal. Between 9 September and 24 October, temperature for each survey decreased from a spatial average (surface and bottom measurements included) of 19.0°C (9 September) to 8.6°C (24 October; Table 3).

3.2 Salinity

Isohalines (Figures 2-6) were established based on the salinity profiles (Appendix B) taken during each survey on the Richibucto and St-Charles Estuaries, as well as Baie du Village. The Richibucto Estuary was visited on 3 occasions (9 September, Figure 2; 16 September, Figure 3; 18 October, Figure 4). St-Charles Estuary (24 October, Figure 5) and Baie du Village (21 October, Figure 6) were surveyed once. Salinity profiles taken in the Richibucto Harbour and Baie du Village area were not restricted to the channel (see Appendix B). Both bays were sampled along 3 transects, with 3 profiles taken each time. Only the middle profiles of each transect were used to plot isohalines.

From River km 8 to River km 14, salinity measurements varied between 21 PSU and 24 PSU during the surveys. Vertical stratification was shown to be relatively weak during each survey (Figures 2 and 3), with vertical salinity gradients less than 0.25 PSU/m and longitudinal gradients less than 0.5 PSU/km in this section of the estuary.

The upper section of the estuary (River km $\geq$ 15) showed a maximum vertical gradient of 6.5 PSU/m for the top 1.0 m of the water column at River km 27 on 16 September (Figure 3). The longitudinal gradient near the surface (< 1.5 m) on 18 October was 1.2 PSU/km. Fresh water (0 PSU) was found near the surface at River km 37 on 18 October (Figure 4).

The St-Charles Estuary (Figure 5) showed a similar pattern to that of the Richibucto Estuary. Fresh water was found near the surface at River km 19, and a maximum vertical gradient of 5 PSU/m in the top 1.0 m of the water column was measured near River km 18. Richibucto Harbour and Baie du Village generally showed higher salinity than the Richibucto and St-Charles estuaries with values ranging between 22 and 26 PSU (Table 3; Appendix B).

In the middle portion of Baie du Village (Figure 6), strong vertical stratification was observed near the entrance of the bay, in the top 1m. The inner bay showed weaker stratification than the entrance, with salinity varying between 23 PSU and 24 PSU for most of the water column.

3.3 Density

Density profiles measured at each station are presented in Appendix C. Overall, water density varied between 1000 kg/m^3 (fresh water) and 1021 kg/m^3 (salinity of 27 PSU). The density profiles have the same shape as the salinity profiles (Appendices B and C). Density in shallow coastal plain estuaries is essentially determined by salinity (Wilson 1988). The pycnoclines occurred at the same depth as the haloclines, which is also indicative of the influence of salinity on density.

3.4 Currents

Isovels (Figures 7-13) were constructed using the U component of the current vectors measured in the Richibucto Estuary, Mill Creek, St-Charles Estuary, and Baie du Village. On 9 September, the negative values found throughout the water column in the main Richibucto River (Figure 7) are indicative of a flood tide (Table 2). Velocities of the U component varied between -150 cm/s and 0 cm/s. There was a general decrease from surface to a depth of 2 m, beyond which 0 cm/s were measured. The high surface currents were likely imputable to wind and wave action and would probably not properly reflect tidal currents alone.

Mill Creek (Figure 1) was surveyed on 12 September (Figure 8) during a period covering the end of the ebb and the beginning of a flood tide. Strong (70 cm/s) positive currents were measured in the top 1 m at the mouth of Mill Creek (River

km 10). Between River km 11 and River km 14, flood currents were measured and decreased from 70 cm/s near the surface to near 0 cm/s near the bottom.

In the Richibucto Estuary, velocities on 16 September (Figure 9) were positive throughout the water column between River km 8 and River km 18, showing the effect of the ebbing tide (Table 2). The weakening of the tidal currents can be seen as sampling progressed upstream, with velocities decreasing from 70 cm/s near the surface at River km 8 to 0 cm/s at River km 18. Between River km 18 and 25, near surface currents were flowing upstream (negative value), perhaps as a consequence of the progression of the tidal cycle during this survey.

Mill Creek showed stronger surface currents on 18 September (Figure 10) than on 12 September, with near surface values reaching 150 cm/s in the upstream direction. Predicted tides calculated at Richibucto Bar were flooding during the sampling period.

On 18 October (Figure 11), velocities in the main Richibucto Estuary varied between -20 cm/s and 50 cm/s near the surface and were close to 0 cm/s near the bottom. Predicted tides on 18 October (Table 2) showed a very small tidal range (0.2 m), which may explain the slow velocities.

Isovels were constructed with 3 stations (middle station of each transect) surveyed in Baie du Village on 21 October (Figure 12). In spite of a small predicted tidal range (0.1 m), measurements showed strong (125 cm/s) near-surface (1 m) velocity, decreasing to less than 25 cm/s near the bottom.

Velocity data from the St-Charles Estuary (Figure 13) showed near-surface currents in the middle portion of the estuary to be stronger (20-70 cm/s) than in the upper portion of the estuary (0-10 cm/s).

4.0 DISCUSSION AND CONCLUSIONS

Data from 45 current meter profiles taken in the Richibucto Estuary between 9 September and 24 October 1996 were presented. Isohalines showed relatively weak vertical stratification in both the Richibucto and St-Charles Estuaries. The tip of the salt wedge (0 PSU) was found to be as far as 37 km upstream of the South Richibucto Dune on 18 October. In the St-Charles Estuary, the tip of the salt wedge was found to be 19 km upstream of the dune on 24 October.

Isovels showed that tidal currents could be sufficiently strong to cause definite current reversals as far up as River km 18 (Big Cove) in the Richibucto Estuary. It should be remembered that the profiles used to build isohalines and isovels were not taken simultanously. Tidal propagation may have an important impact in the interpretation of isovels and isohaline plots. In most cases, all stations used for a given plot were done within one ebb or flood cycle. However, the strength of the tidal current varies during each flood or ebb. These varying current velocities could only be quantified via intensive (e.g. sampling frequency < 1/hour) sampling at a given station or by mooring a current meter for at least one complete tidal cycle. This was not possible during this survey.

As expected, density measurements were found to be strongly modulated by salinity. Temperatures varied between 6.5°C and 19°C during the survey period. In most cases, no significant vertical thermal stratification occurred.

This survey of physical oceanographic measurements in the Richibucto Estuary provided some, albeit limited, information on temperature, salinity and currents during the fall season of 1996. A more thorough investigation of the physical oceanography, which would incorporate the quantification of variations at the seasonal, fortnightly and semi-diurnal tidal cycles, would enhance our understanding of water movement and assist other scientists involved in biological or chemical projects.

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Table 1. Sensors Range and Precision

Sensors	Range	Precision
S4P Velocity	0-350 cm/s	± 1 cm/s
S4P Compass	0-360°	± 2°
S4P Conductivity	5-70 mS/cm	± 0.2 mS/cm
S4P Pressure	0-1000 dbar	± 0.5 dbar
S4P Temperature	-5-45°C	± 0.05°C
YSI Temperature	-2-50 °C	± 0.5°C
YSI Salinity	0-40 PPT	± 0.5 PPT

Table 2. Station numbers with sampling date, distance from South Richibucto Dune (River km 0), sampling time, and predicted tides.

Station	Date	Distance (km)	Time (hh:mm)	Predicted tides A.M. / m	P.M. / m
RR1[1]	16-Sept-96	8.4	13:50	08:00 / 0.72	14:02 / 0.39
RR3	16-Sept-96	11.0	13:30	08:00 / 0.72	14:02 / 0.39
RR4	09-Sept-96	11.9	14:35	11:32 / 0.45	16:25 / 0.57
RR4	12-Sept-96	11.9	11:00	12:27 / 0.42	17:45 / 0.72
RR4	16-Sept-96	11.9	13:15	08:00 / 0.72	14:02 / 0.39
RR4	18-Sept-96	11.9	14:30	09:25 / 0.57	14:42 / 0.42
RR5	09-Sept-96	12.9	14:25	11:32 / 0.45	16:25 / 0.57
RR5	12-Sept-96	12.9	11:15	12:27 / 0.42	17:45 / 0.72
RR5	16-Sept-96	12.9	13:00	08:00 / 0.72	14:02 / 0.39
RR6	09-Sept-96	14.1	14:10	11:32 / 0.45	16:25 / 0.57
RR6	18-Sept-96	14.1	14:15	09:25 / 0.57	14:42 / 0.42
RR7	09-Sept-96	14.8	13:55	11:32 / 0.45	16:25 / 0.57
RR7	16-Sept-96	14.8	12:45	08:00 / 0.72	14:02 / 0.39
RR8	09-Sept-96	16.2	13:40	11:32 / 0.45	16:25 / 0.57
RR9	09-Sept-96	17.3	13:20	11:32 / 0.45	16:25 / 0.57
RR10	09-Sept-96	17.4	13:05	11:32 / 0.45	16:25 / 0.57
RR10	16-Sept-96	17.4	12:30	08:00 / 0.72	14:02 / 0.39
RR11	16-Sept-96	20.0	12:15	08:00 / 0.72	14:02 / 0.39
RR11	18-Oct-96	20.0	14:35	11:00 / 0.55	14:42 / 0.45
RR12	18-Oct-96	20.9	14:20	11:00 / 0.55	14:42 / 0.45
RR13	16-Sept-96	23.2	12:00	08:00 / 0.72	14:02 / 0.39
RR13	18-Oct-96	23.2	14:10	11:00 / 0.55	14:42 / 0.45
RR14	16-Sept-96	25.2	11:45	08:00 / 0.72	14:02 / 0.39
RR15	16-Sept-96	28.7	11:20	08:00 / 0.72	14:02 / 0.39
RR15	18-Oct-96	28.7	13:55	11:00 / 0.55	14:42 / 0.45
RR16	18-Oct-96	34.0	13:40	11:00 / 0.55	14:42 / 0.45
RR17	18-Oct-96	36.1	13:30	11:00 / 0.55	14:42 / 0.45

[1] RR : Richibucto River

Table 2 (*continued*). Station numbers with sampling date, distance from River South Richibucto Dune (River km 0), sampling time, and predicted tides.

Station	Date	Distance (km)	Time (hh:mm)	Predicted tides A.M. / m	P.M. / m
RR18[1]	18-Oct-96	37.9	13:15	11:00 / 0.55	14:42 / 0.45
RR19	18-Oct-96	41.2	13:00	11:00 / 0.55	14:42 / 0.45
MC1[2]	18-Sept-96	11.6	14:15	09:25 / 0.58	14:42 / 0.42
MC2	18-Sept-96	13.0	13:00	09:25 / 0.58	14:42 / 0.42
MC3	18-Sept-96	14.5	13:20	09:25 / 0.58	14:42 / 0.42
MC4	18-Sept-96	15.0	13:45	09:25 / 0.58	14:42 / 0.42
BV1[3]	21-Oct-96	10.0	15:20	07:27 / 0.39	13:20 / 0.64
BV2	21-Oct-96	9.8	15:30	07:27 / 0.39	13:20 / 0.64
BV3	21-Oct-96	7.7	15:40	07:27 / 0.39	13:20 / 0.64
BV4	21-Oct-96	8.4	15:45	07:27 / 0.39	13:20 / 0.64
BV5	21-Oct-96	8.5	15:50	07:27 / 0.39	13:20 / 0.64
BV6	21-Oct-96	8.6	15:58	07:27 / 0.39	13:20 / 0.64
BV7	21-Oct-96	8.1	16:00	07:27 / 0.39	13:20 / 0.64
BV8	21-Oct-96	8.0	16:08	07:27 / 0.39	13:20 / 0.64
BV9	21-Oct-96	7.6	16:15	07:27 / 0.39	13:20 / 0.64
RH1[4]	24-Oct-96	5.0	12:05	09:57 / 0.36	15:35 / 0.85
RH2	24-Oct-96	4.6	12:10	09:57 / 0.36	15:35 / 0.85
RH3	24-Oct-96	4.3	12:18	09:57 / 0.36	15:35 / 0.85
RH4	24-Oct-96	2.8	12:25	09:57 / 0.36	15:35 / 0.85
RH5	24-Oct-96	2.8	12:40	09:57 / 0.36	15:35 / 0.85
RH6	24-Oct-96	2.8	12:45	09:57 / 0.36	15:35 / 0.85
RH7	24-Oct-96	1.9	12:55	09:57 / 0.36	15:35 / 0.85
RH8	24-Oct-96	1.9	13:10	09:57 / 0.36	15:35 / 0.85
NWB1[5]	24-Oct-96	7.1	13:30	09:57 / 0.36	15:35 / 0.85
NWB2	24-Oct-96	8.4	13:45	09:57 / 0.36	15:35 / 0.85
NWB3	24-Oct-96	13.4	14:00	09:57 / 0.36	15:35 / 0.85
NWB4	24-Oct-96	20.2	14:15	09:57 / 0.36	15:35 / 0.85
NWB5	24-Oct-96	20.6	14:30	09:57 / 0.36	15:35 / 0.85

[1]RR: Richibucto River
[2]MC: Mill Creek
[3]BV: Baie du Village
[4]RH: Richibucto Harbour
[5]NWB: Northwest Branch

Table 3. Maximum sampling depths, surface and bottom salinity and temperature measured with the *YSI* for each station.

Station	Date	Max. Depth (m)	Surface Salinity (PPT)	Surface Temp. (°C)	Bottom Salinity (PPT)	Bottom Temp. (°C)
RR1	16-Sept-96	3.0	23.0	16.0	23.0	16.0
RR3	16 -Sept-96	2.0	23.0	16.0	23.0	16.5
RR4	09 -Sept-96	1.5	19.0	19.0	19.0	19.0
RR4	16 -Sept-96	4.5	23.0	16.5	23.0	16.5
RR4	18 -Sept-96	4.0	24.0	16.0	24.5	16.0
RR5	09 -Sept-96	2.7	19.0	19.0	19.5	19.0
RR5	16 -Sept-96	2.5	22.0	16.0	23.0	16.5
RR6	09 -Sept-96	2.8	18.8	19.0	19.0	19.0
RR6	18 -Sept-96	3.5	22.0	16.4	24.0	16.0
RR7	09 -Sept-96	3.7	18.2	19.0	18.5	19.0
RR7	16 -Sept-96	4.5	22.0	15.8	22.5	16.5
RR8	09 -Sept-96	4.2	17.5	19.5	19.0	19.0
RR9	09 -Sept-96	4.5	18.0	19.0	18.2	19.0
RR10	09 -Sept-96	3.8	15.0	20.0	16.0	19.0
RR10	16 -Sept-96	4.5	21.0	17.0	21.5	16.5
RR11	16 -Sept-96	4.5	20.5	16.5	21.5	16.5
RR11	18 -Sept-96	4.5	20.0	8.0	21.0	8.0
RR12	18 -Oct-96	1.5	19.0	7.0	19.0	7.0
RR13	16 -Sept-96	4.0	19.0	16.5	20.0	16.5
RR13	18 -Sept-96	2.5	17.0	8.0	17.0	8.0
RR14	16 -Sept-96	4.5	18.0	15.0	19.0	14.0
RR15	16 -Sept-96	4.5	15.0	16.0	17.0	16.0
RR15	18 -Oct-96	3.5	14.0	7.0	14.0	7.0
RR16	18 -Oct-96	3.0	10.0	7.0	12.0	7.0
RR17	18 -Oct-96	2.5	7.0	7.0	11.0	7.0
RR18	18 -Oct-96	2.0	5.0	6.0	10.0	6.0
RR19	18 -Oct-96	1.5	0.0	4.0	2.0	4.0

[1]RR: Richibucto River

Table 3 (*continued*). Maximum sampling depths, surface and bottom salinity and temperature measured with the YSI for each station.

Station	Date	Max. Depth (m)	Surface Salinity (PPT)	Surface Temp. (°C)	Bottom Salinity (PPT)	Bottom Temp. (^{0}C)
MC1	18 -Sept-96	3.0	19.0	16.0	21.0	16.0
MC2	18 -Sept-96	1.2	20.5	17.0	21.0	17.0
MC3	18 -Sept-96	2.5	19.7	16.5	22.5	16.0
MC4	18 -Sept-96	1.3	21.5	17.0	22.5	17.0
BV1	21 -Oct-96	1.5	23.0	7.0	24.0	7.0
BV2	21 -Oct-96	1.5	23.0	7.0	24.0	7.0
BV3	21 -Oct-96	1.5	21.0	6.0	22.0	6.0
BV4	21 -Oct-96	2.0	22.5	6.5	24.0	7.0
BV5	21 -Oct-96	2.0	23.5	7.0	24.5	7.0
BV6	21 -Oct-96	2.0	23.0	7.0	24.0	6.5
BV7	21 -Oct-96	1.0	25.0	8.0	25.0	8.0
BV8	21 -Oct-96	1.5	24.0	6.5	26.0	7.0
BV9	21 -Oct-96	4.7	25.0	7.5	26.0	7.5
RH1	24 -Oct-96	1.5	22.0	9.0	25.0	9.0
RH2	24 -Oct-96	4.2	21.5	7.8	25.5	8.3
RH3	24 -Oct-96	4.3	22.0	8.0	23.0	8.5
RH4	24 -Oct-96	2.0	23.1	8.4	22.4	8.3
RH5	24 -Oct-96	7.5	22.3	8.2	24.0	8.7
RH6	24 -Oct-96	0.8	23.0	8.9	23.2	8.3
RH7	24 -Oct-96	2.1	22.9	8.5	22.9	8.5
RH8	24 -Oct-96	6.2	22.5	8.5	23.3	8.6
NWB1	24 -Oct-96	2.5	20.1	8.1	20.2	8.0
NWB2	24 -Oct-96	2.1	22.3	8.0	22.8	8.0
NWB3	24 -Oct-96	4.3	21.5	8.9	20.0	8.0
NWB3	24 -Oct-96	2.2	8.0	9.0	12.0	9.0
NWB4	24 -Oct-96	2.0	3.5	9.0	12.0	9.0
NWB5	24 -Oct-96	2.1	0.0	9.0	11.0	9.0

[1]RR: Richibucto River
[3]BV: Baie du Village
[2]MC: Mill Creek
[4]RH: Richibucto Harbour
[5]NWB: Northwest Branch

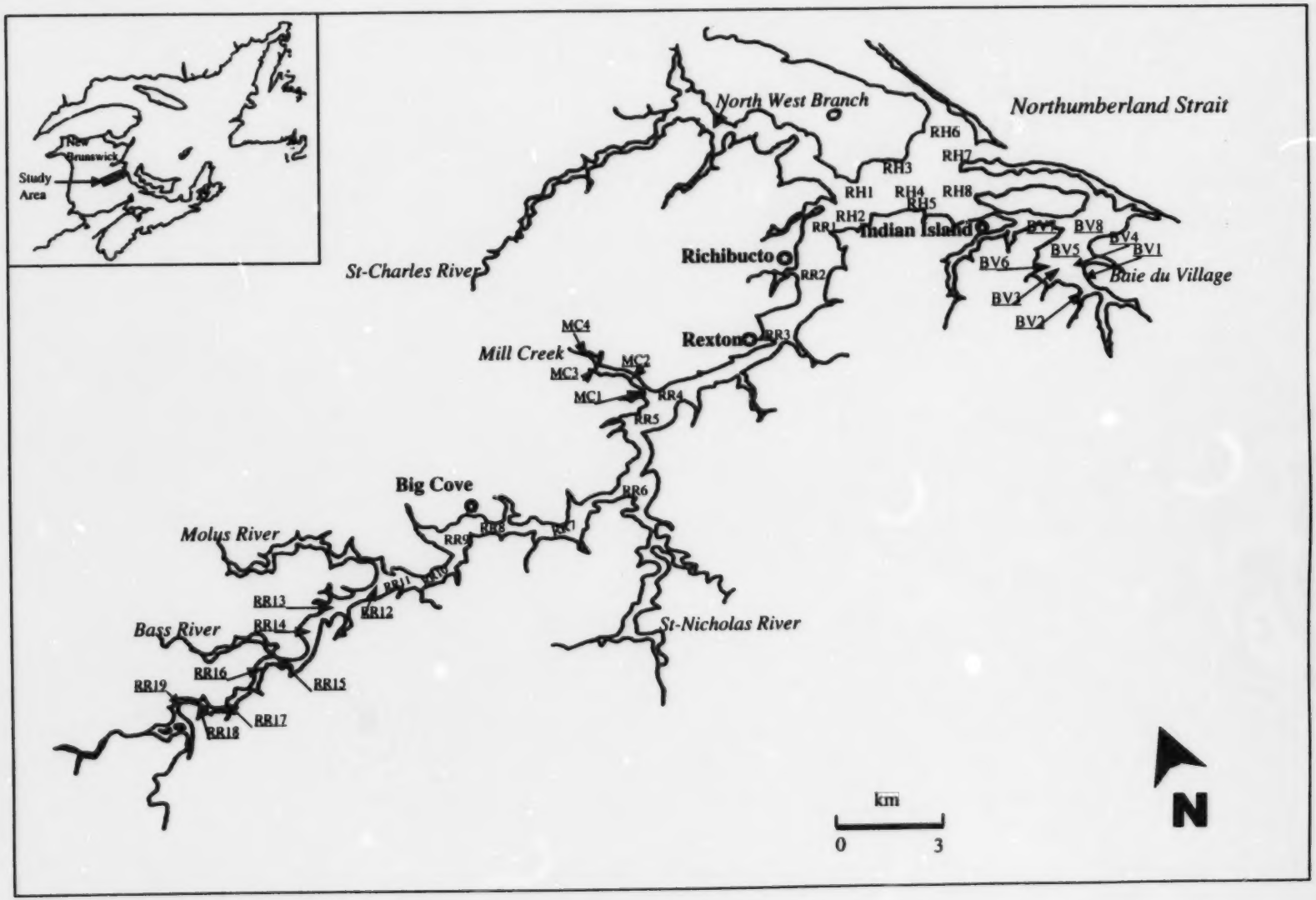


Figure 1. Richibucto Estuary with station locations.

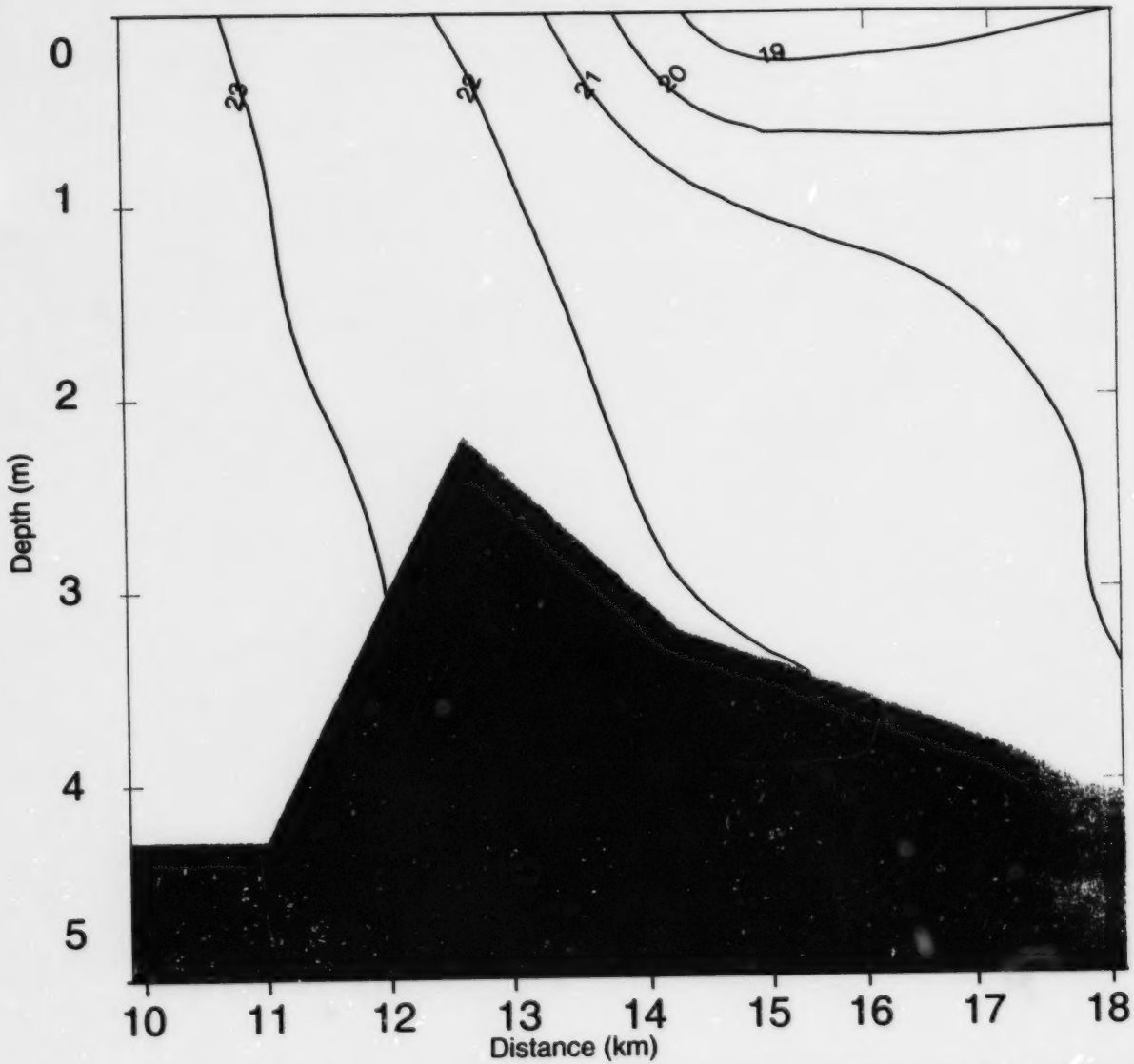


Figure 2. Isohalines (PSU), Richibucto Estuary, 9 September 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

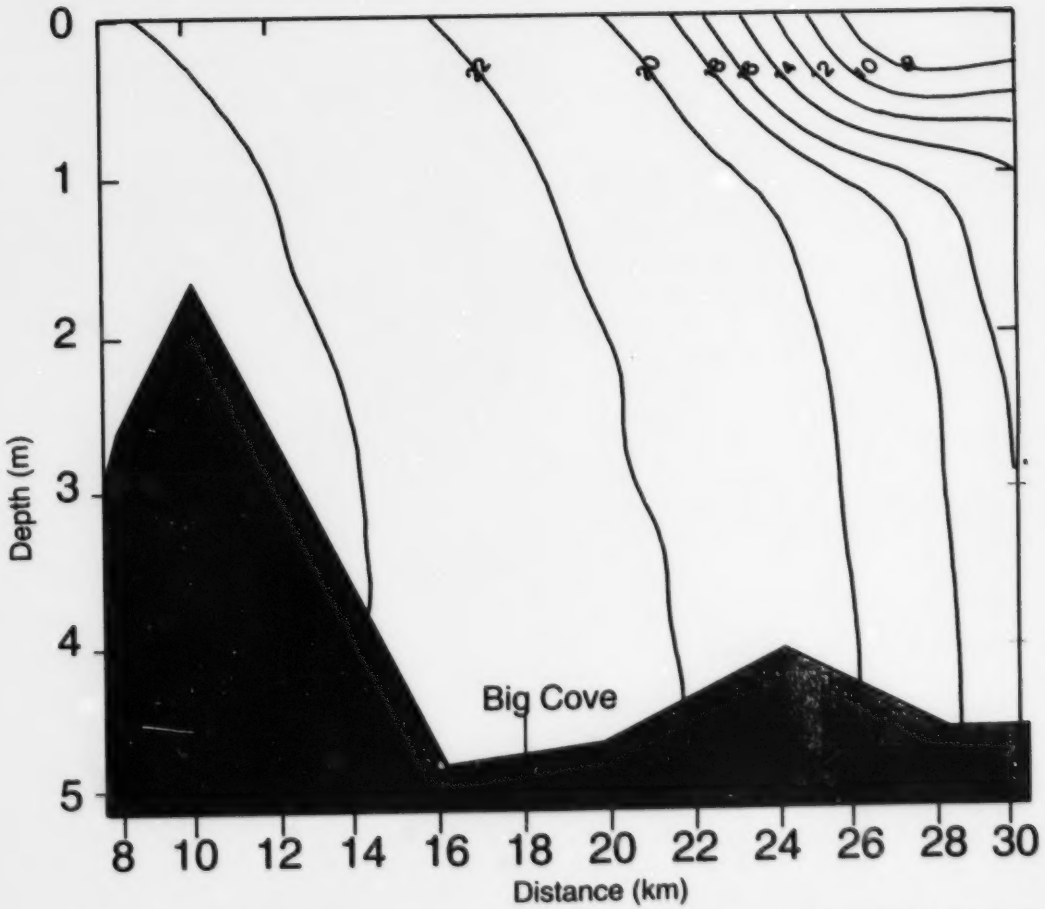


Figure 3. Isohalines (PSU), Richibucto Estuary, 16 September 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

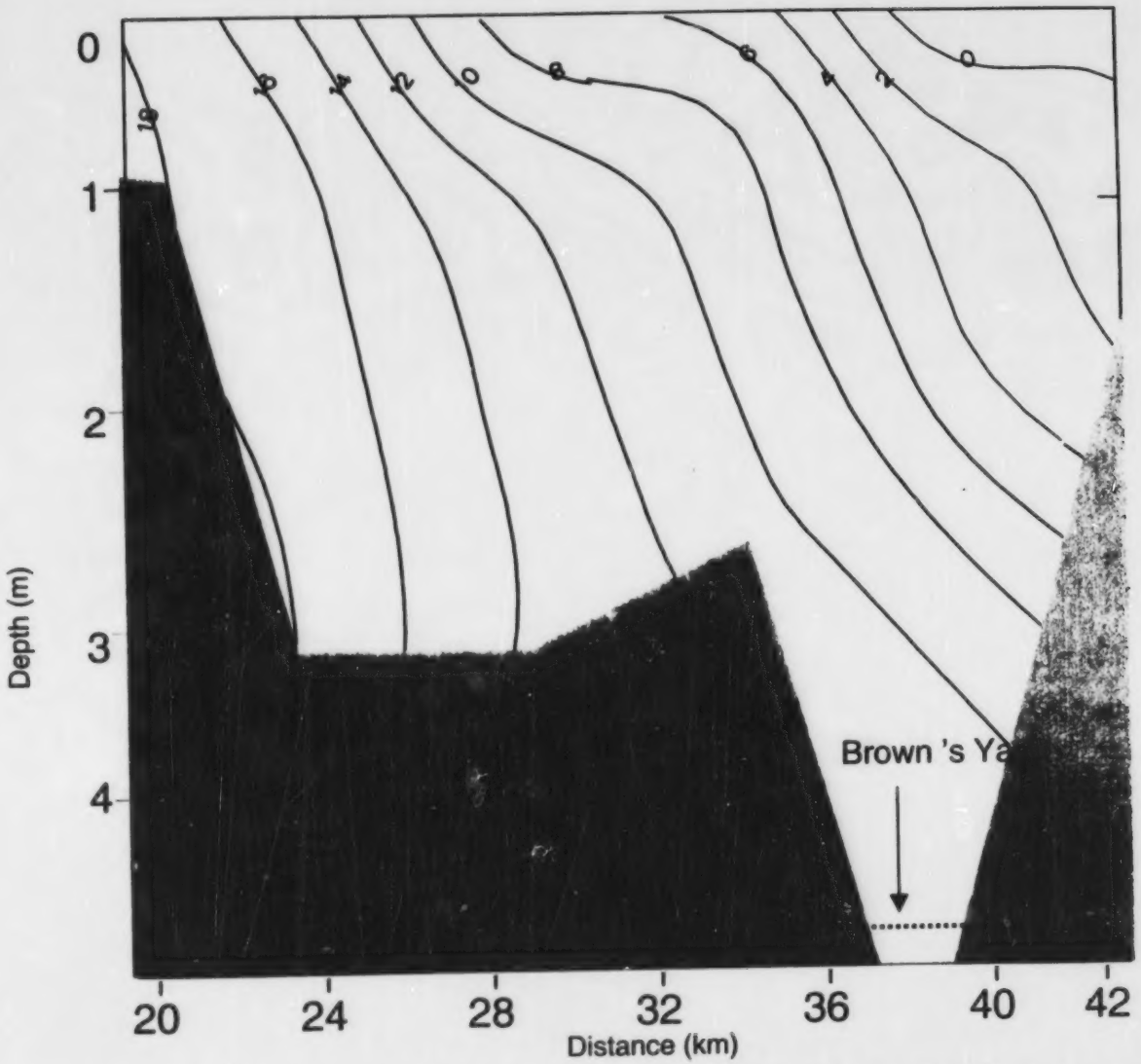


Figure 4. Isohalines (PSU), Richibucto Estuary, 18 October 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary acually sampled.

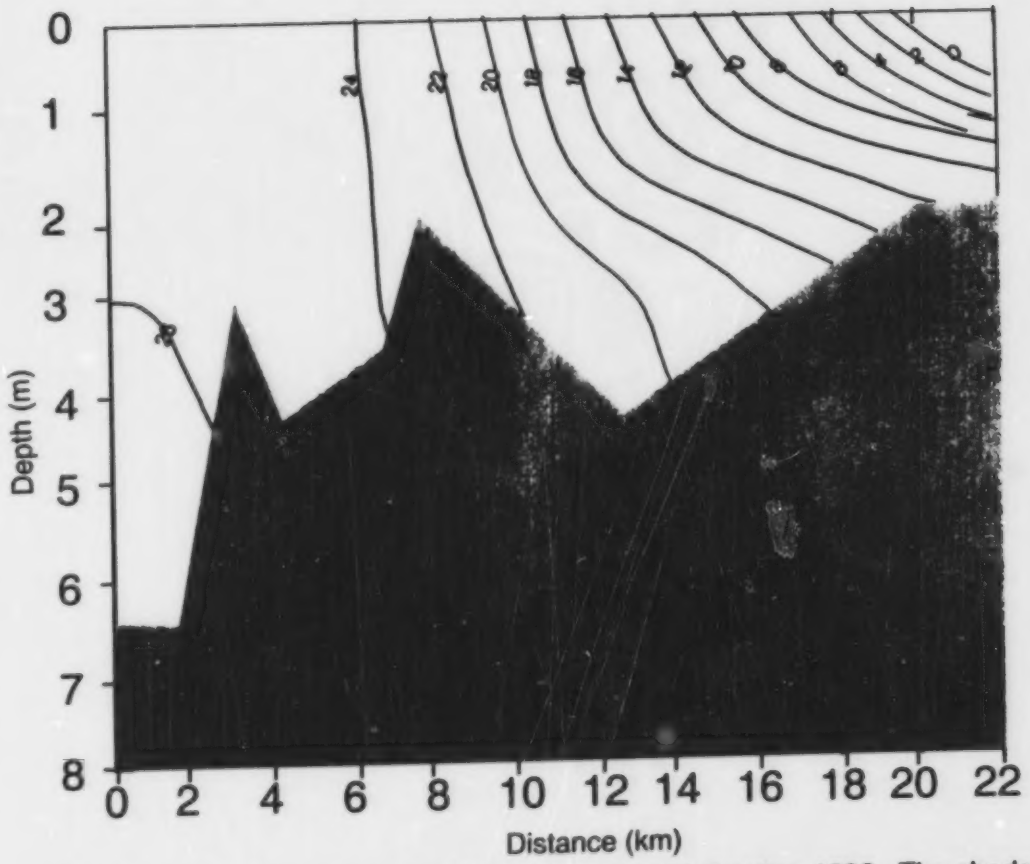


Figure 5. Isohalines (PSU), St-Charles Estuary, 24 October 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

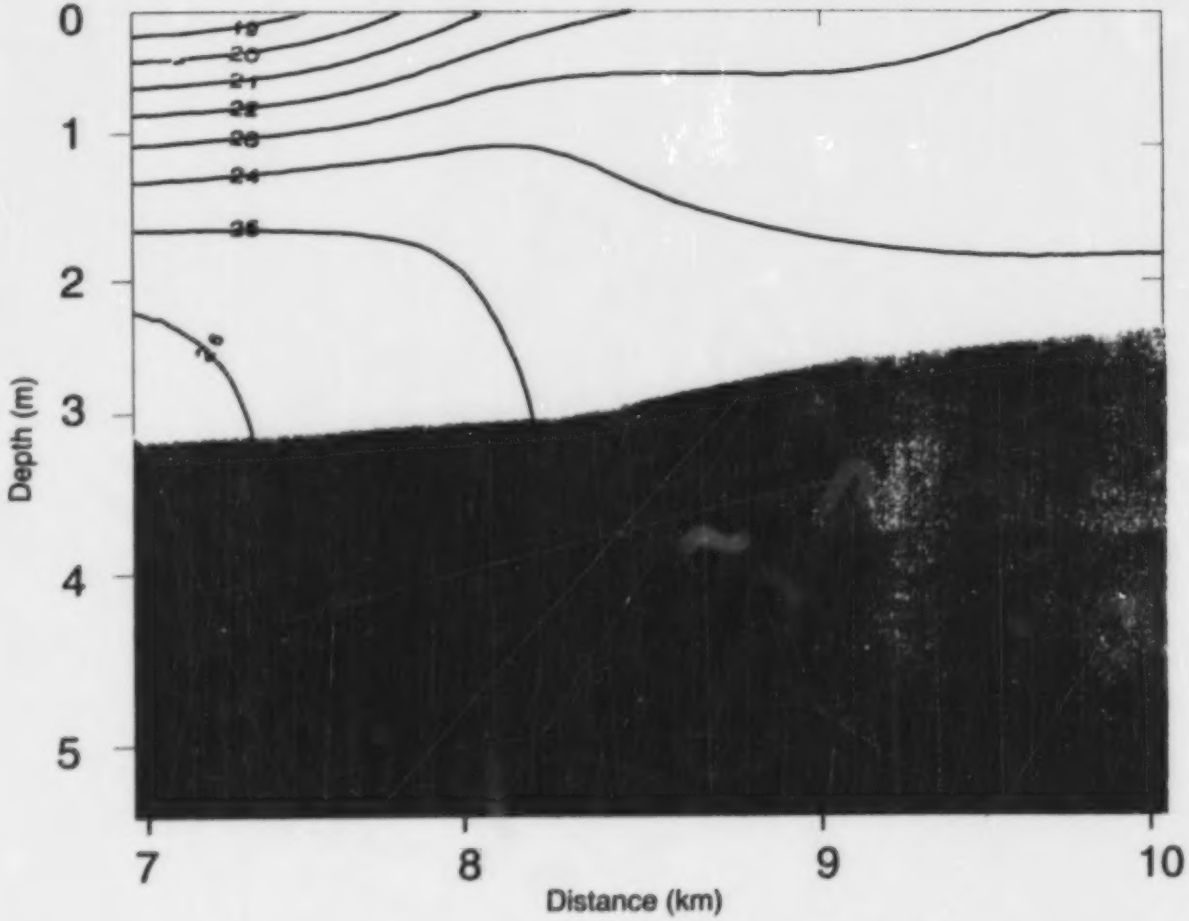


Figure 6. Isohalines (PSU), Baie du Village, 21 October 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

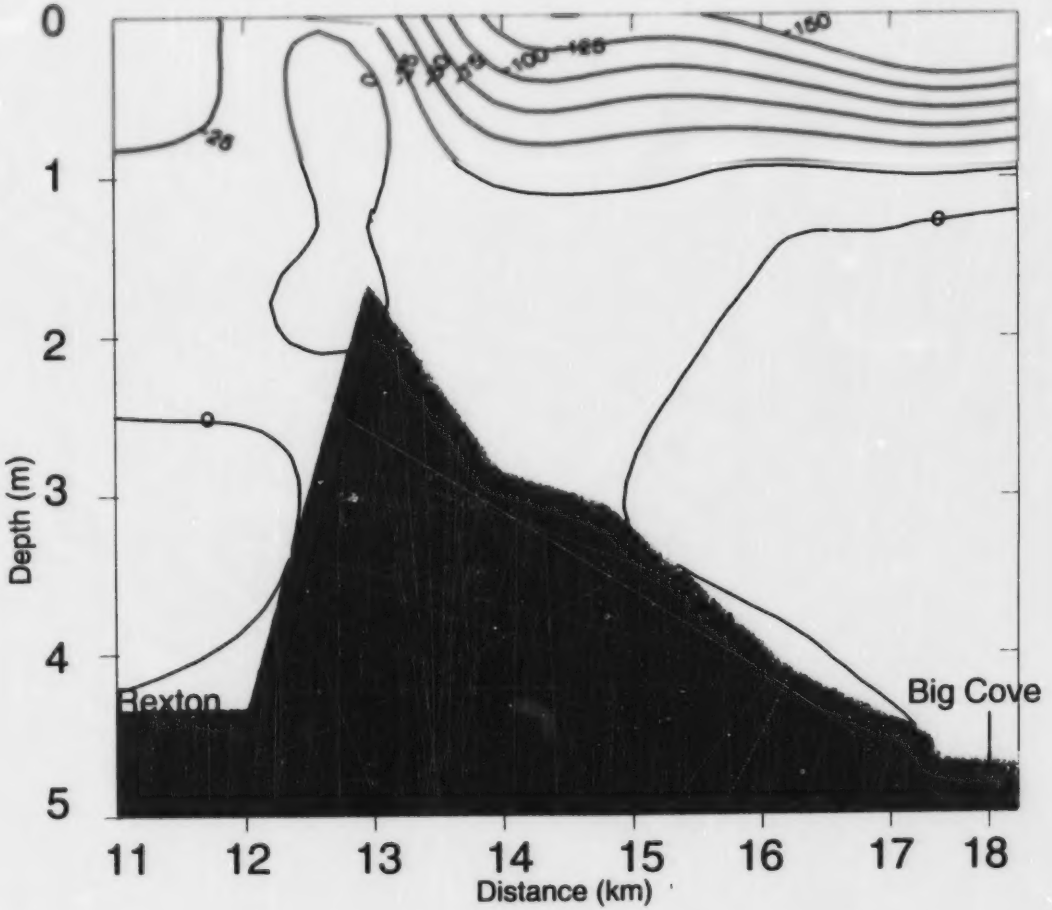


Figure 7. Isovels (cm/s), Richibucto Estuary, 9 September 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

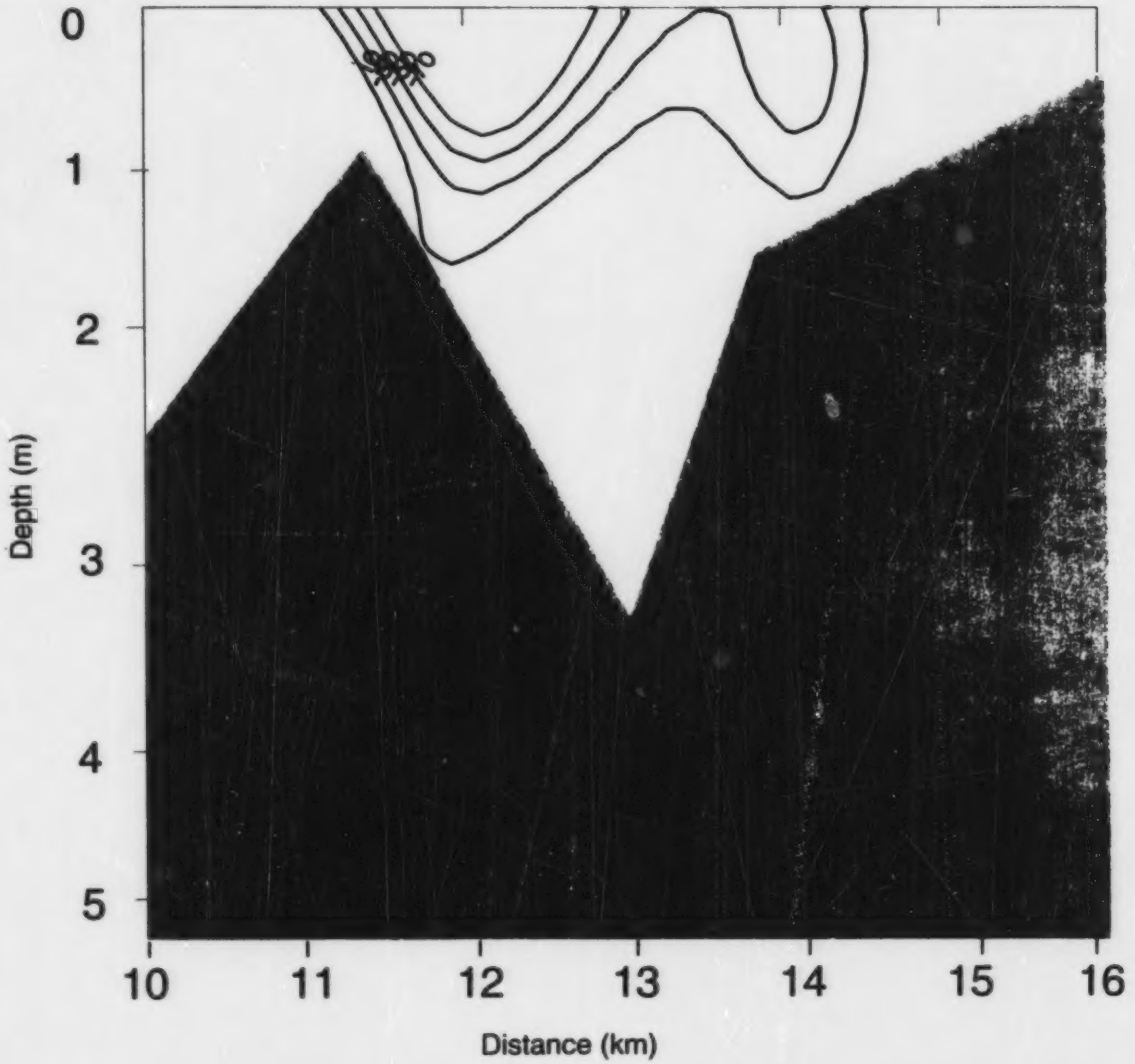


Figure 8. Isovels (cm/s), Mill Creek, 12 September 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

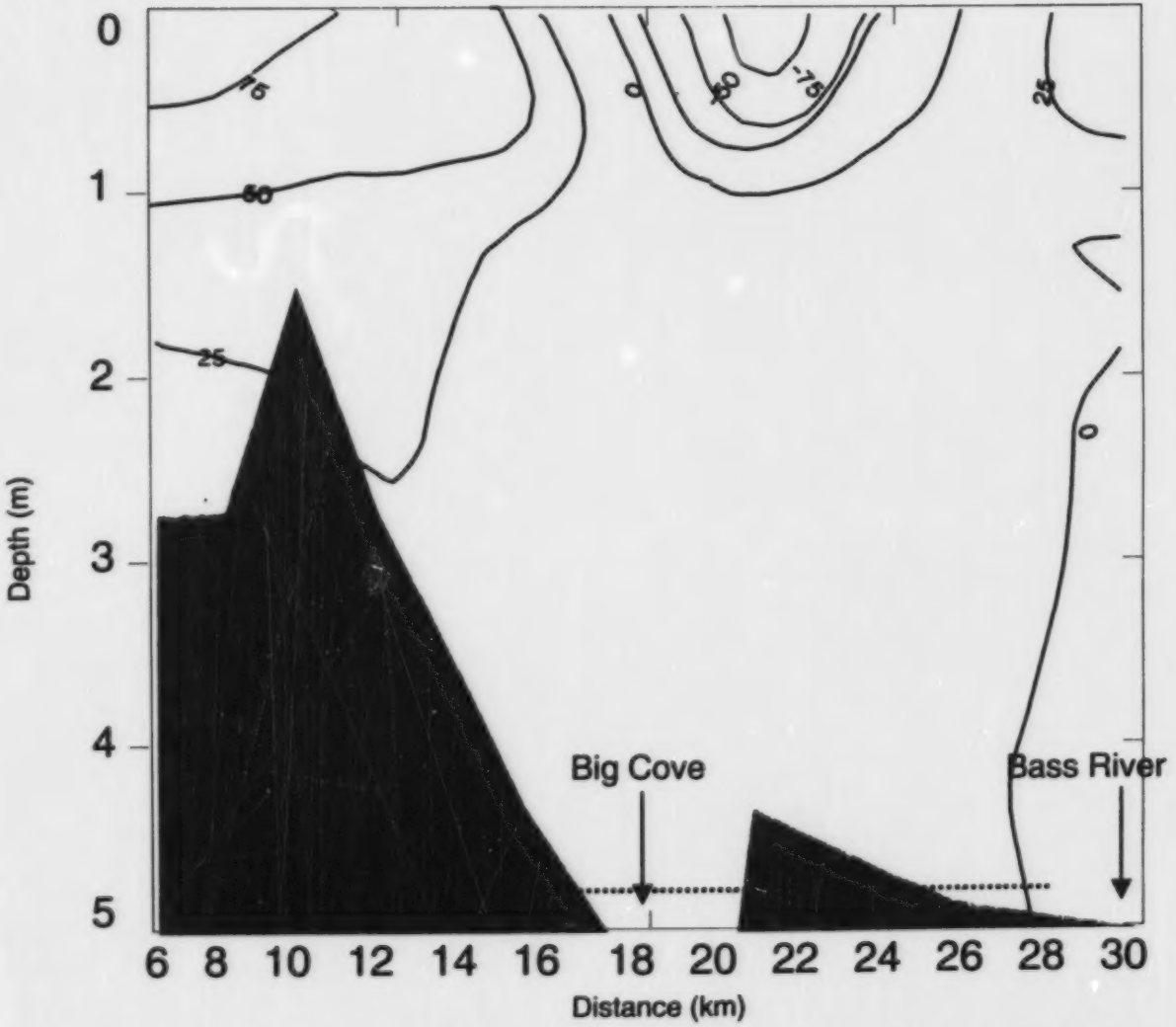


Figure 9. Isovels (cm/s), Richibucto Estuary, 16 September 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

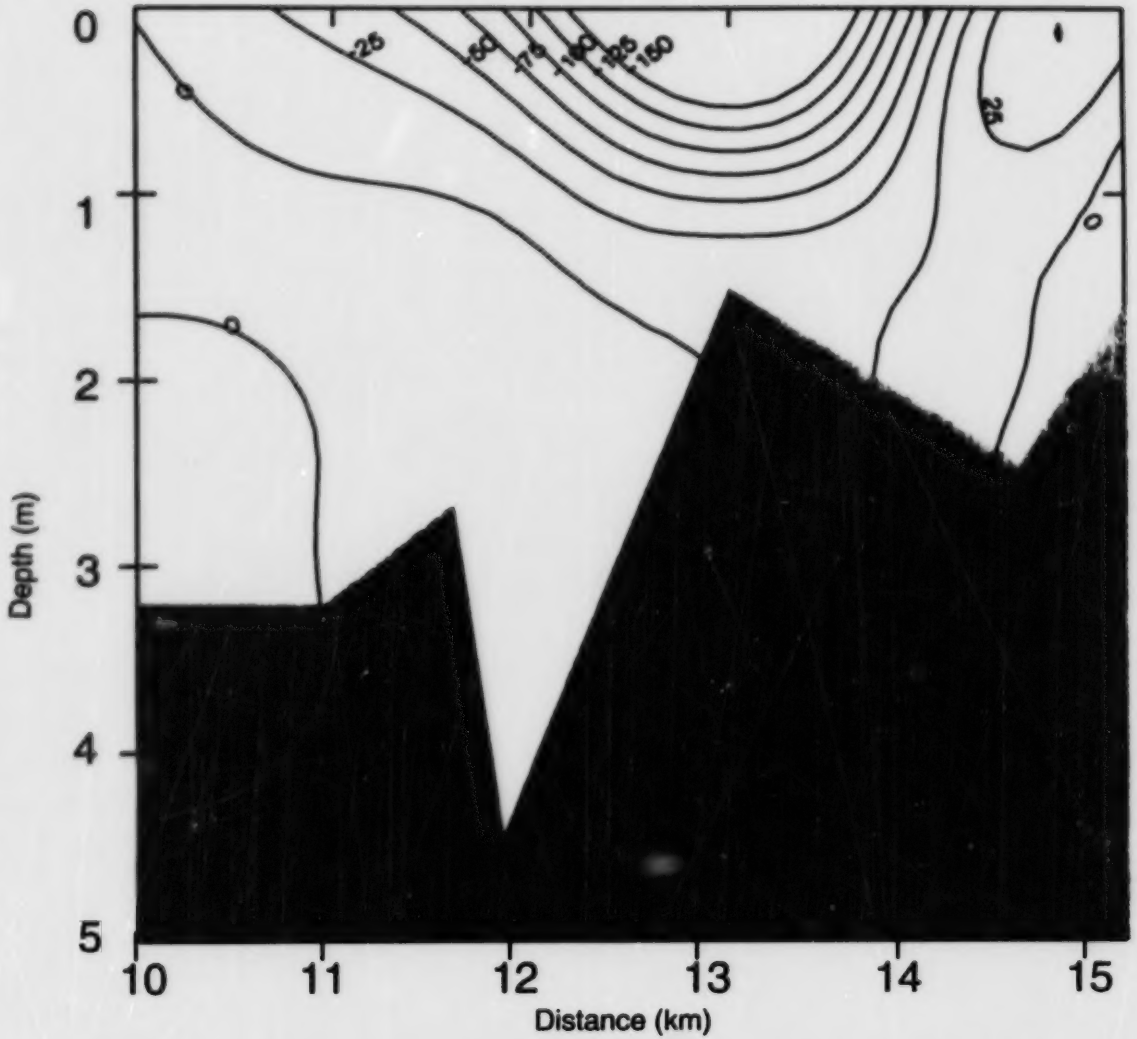


Figure 10. Isovels (cm/s), Mill Creek, 18 September 1996. The shaded area represents the bottom. The distances are measures from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

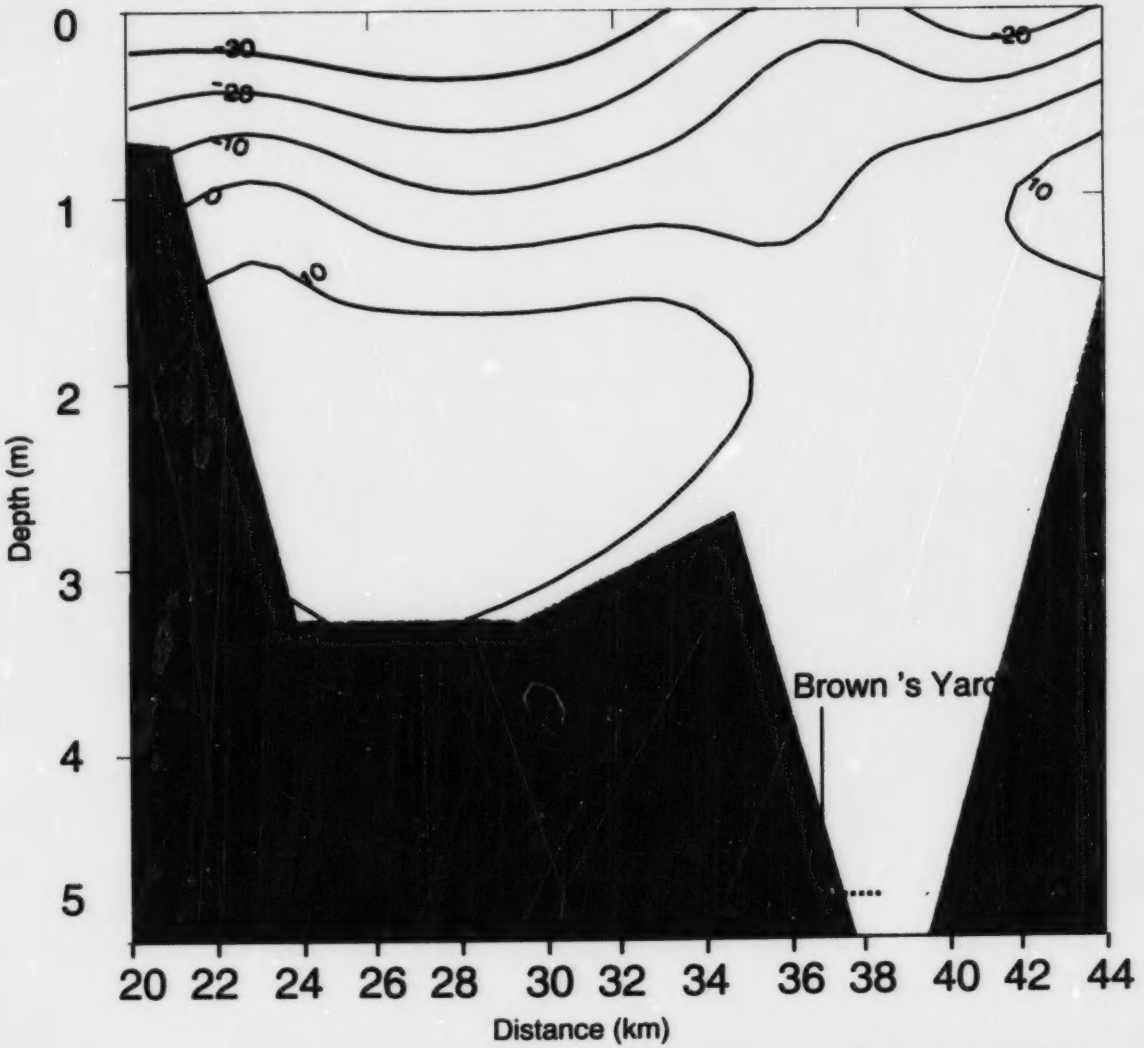


Figure 11. Isovels (cm/s), Richibucto Estuary, 18 October 1996. The shaded area represents the bottom. Lines show the current velocity in (cm/s)., positive going upstream. The distances are measured from South Richibucto dune (km 0), going upstream.

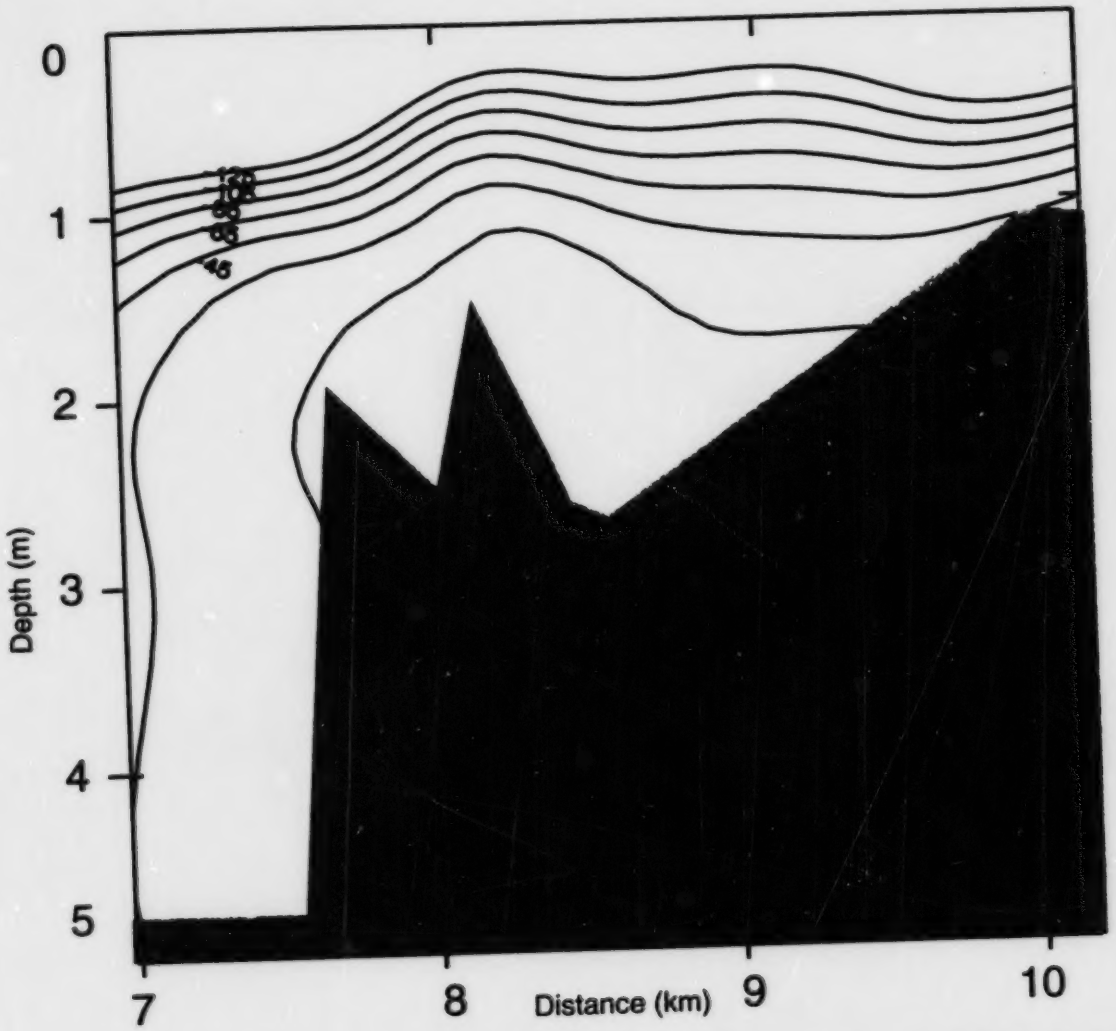


Figure 12. Isovels (cm/s), Baie du Village, 21 October 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

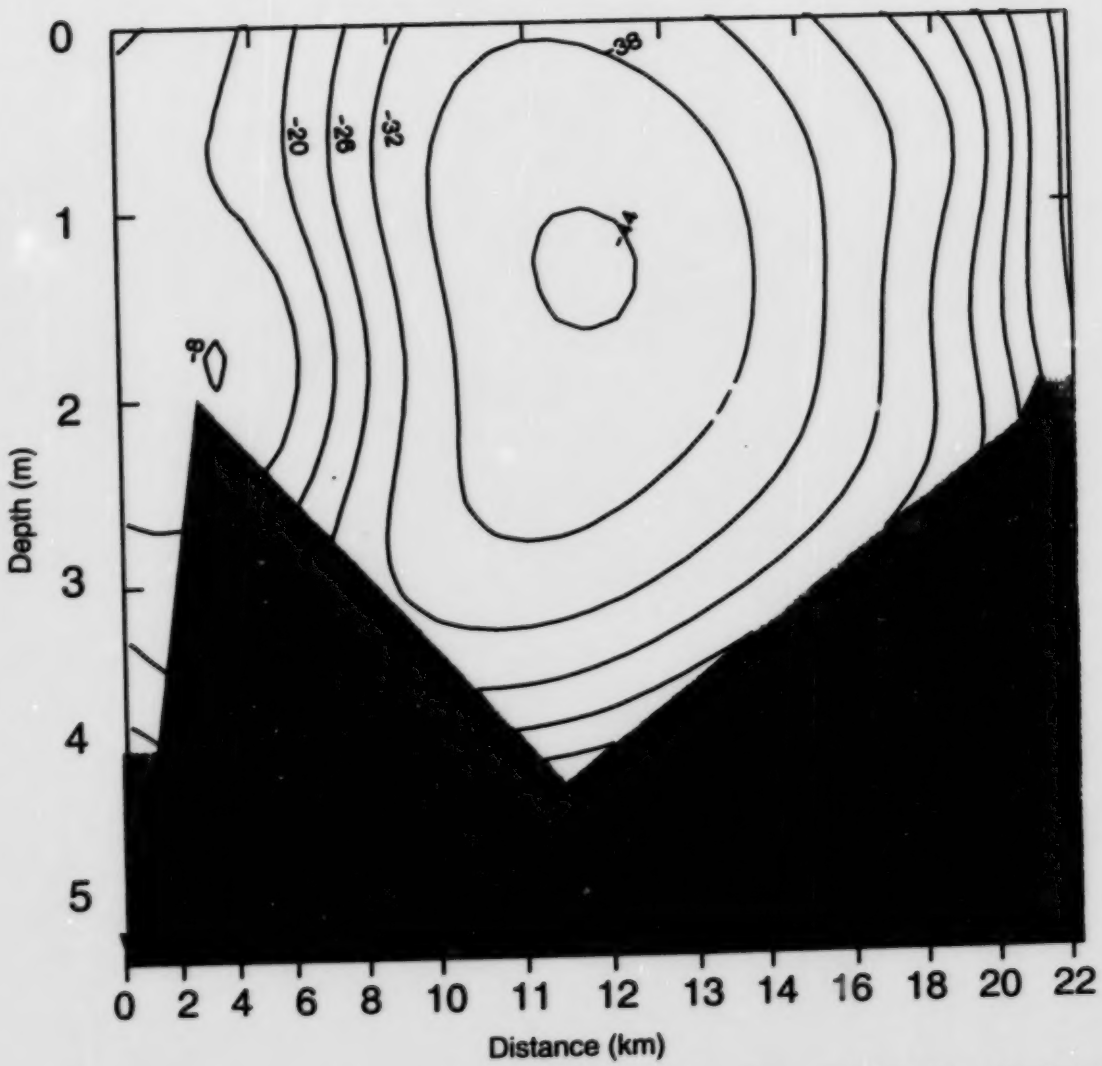
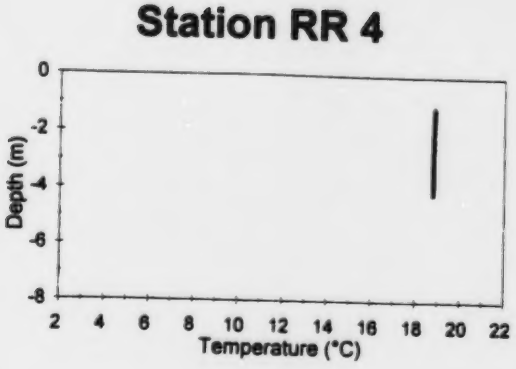


Figure 13. Isovels (cm/s), St-Charles Estuary, 24 October 1996. The shaded area represents the bottom. The distances are measured from South Richibucto dune (km 0), going upstream. Dashed line represents longitudinal section of the estuary actually sampled.

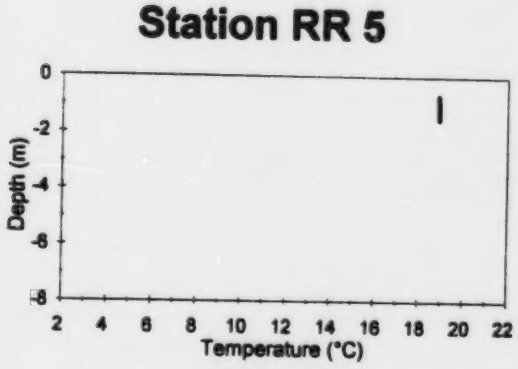
APPENDIX A

TEMPERATURE PROFILES

A1)



A2)



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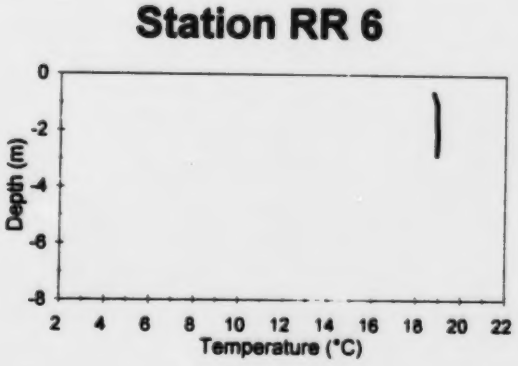
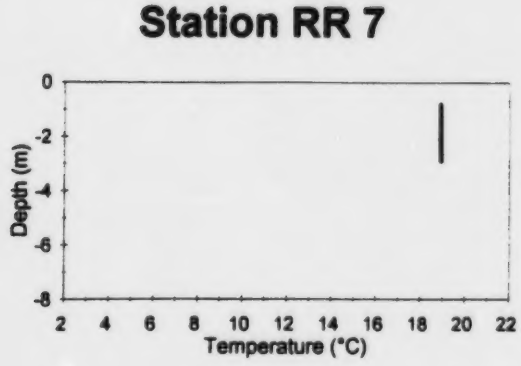
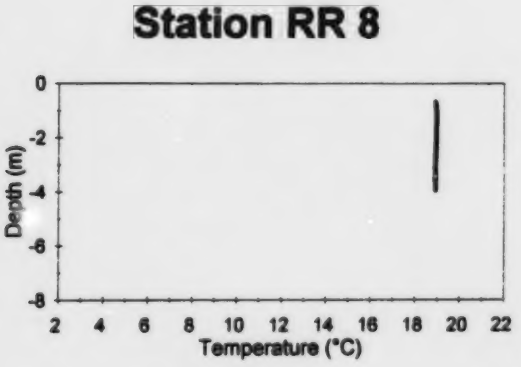


Figures A1, A2 and A3. Temperature profiles at stations RR4, RR5 and RR6, 9 Sept. 1996.

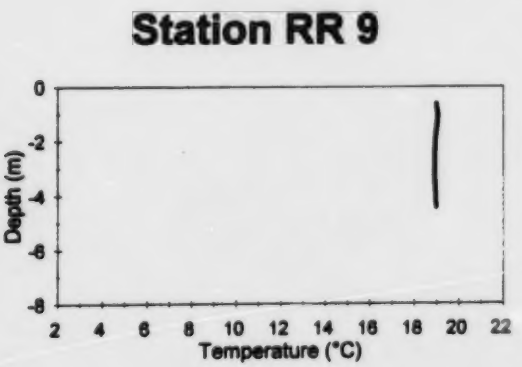
A4)



A5)



A6)



Figures A4, A5 and A6. Temperature profiles at stations RR7, RR8 and RR9, 9 Sept. 1996.

A7)

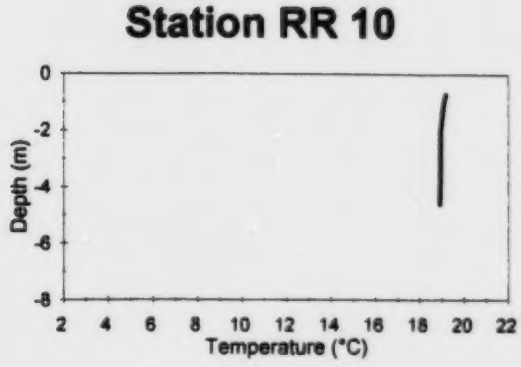
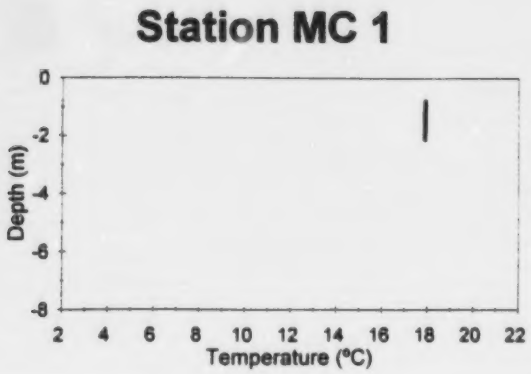
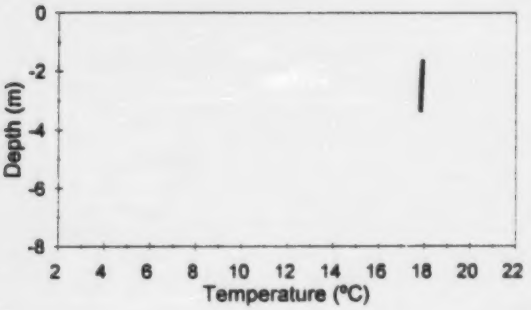


Figure A7. Temperature profile at station RR10, 9 Sept. 1996.

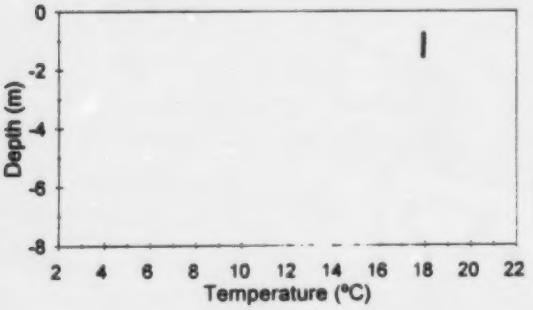
A8)



A9)

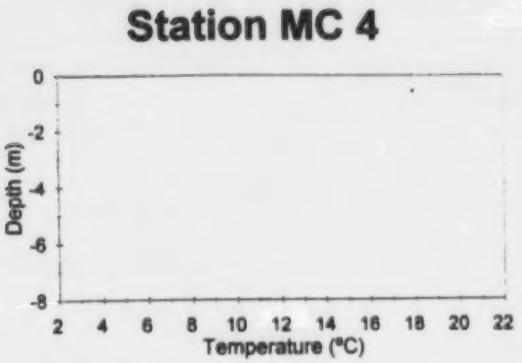


A10)

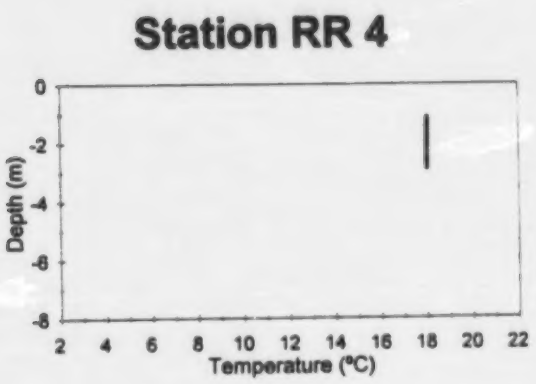


Figures A8, A9 and A10. Temperature profiles at stations MC1, MC2 and MC3, 12 Sept. 1996.

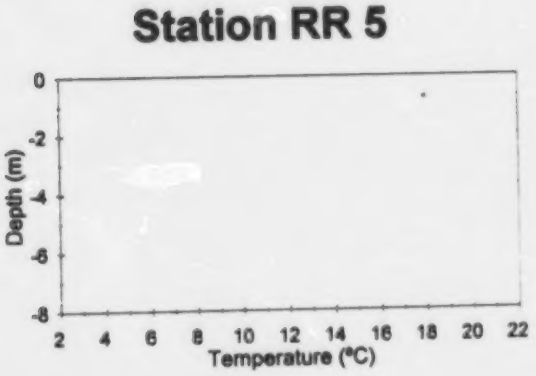
A11)



A12)

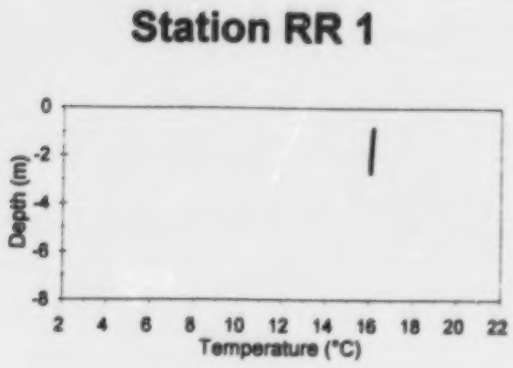


A13)

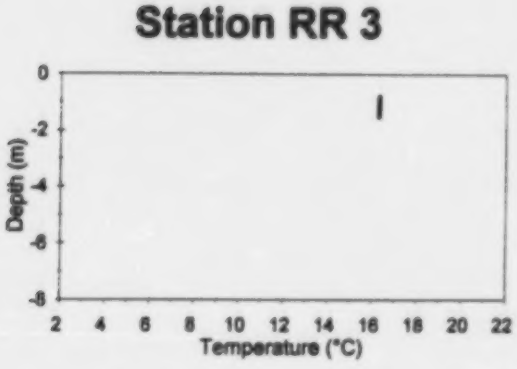


Figures A11, A12 and A13. Temperature profiles at stations MC4, RR4 and RR5, 12 Sept. 1996.

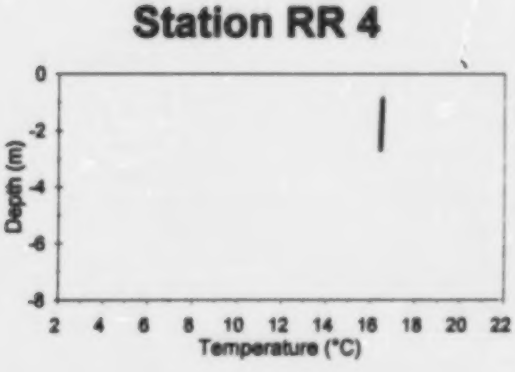
A14)



A15)

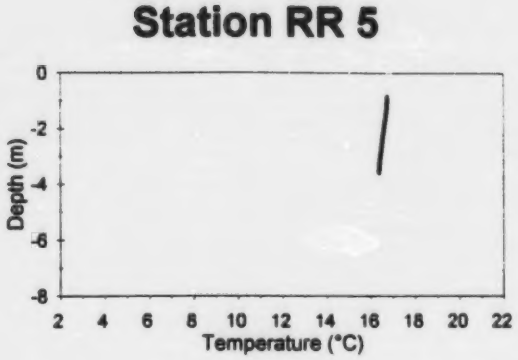


A16)

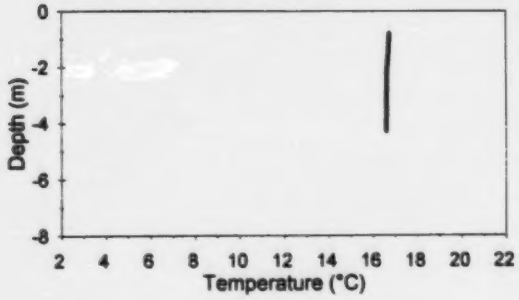


Figures A14, A15 and A16. Temperature profiles at stations RR1, RR3 and RR4, 16 Sept. 1996.

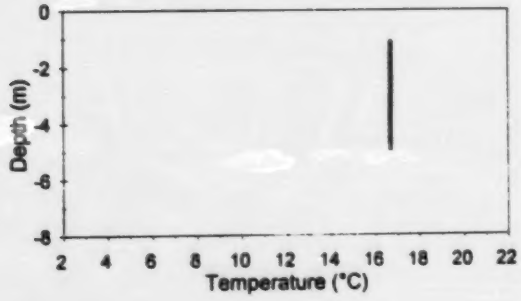
A17)



A18)

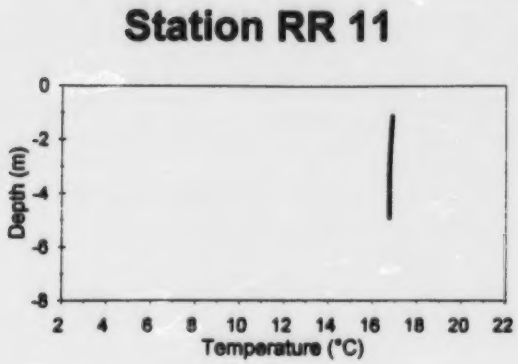


A19)

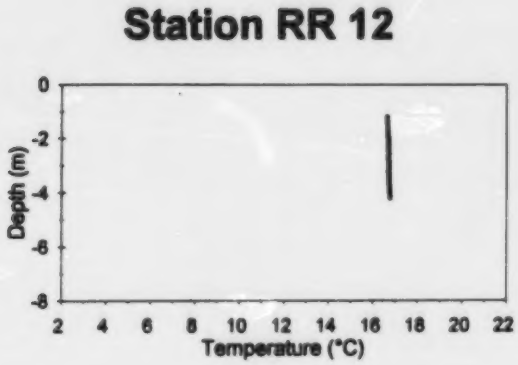


Figures A17, A18 and A19. Temperature profiles at stations RR5, RR7 and RR10, 16 Sept. 1996.

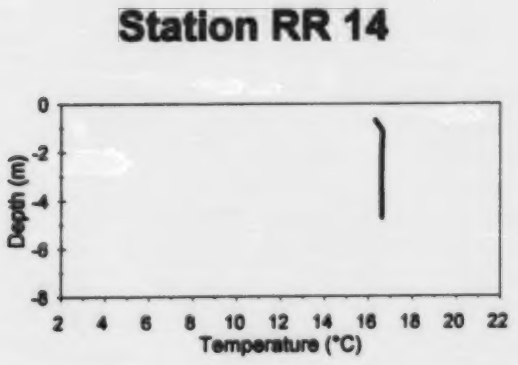
A20)



A21)



A22)



Figures A20, A21 and A22. Temperature profiles at RR11, RR12 and RR14, 16 Sept. 1996.

A23)

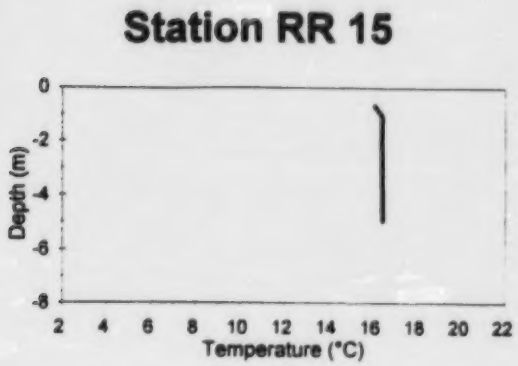
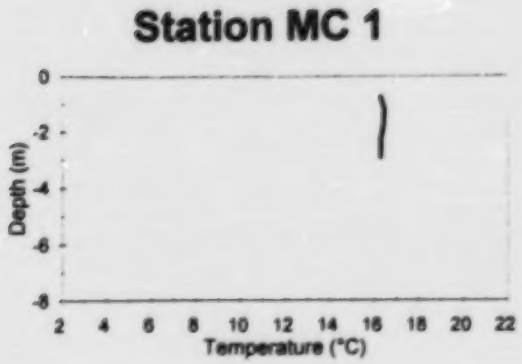
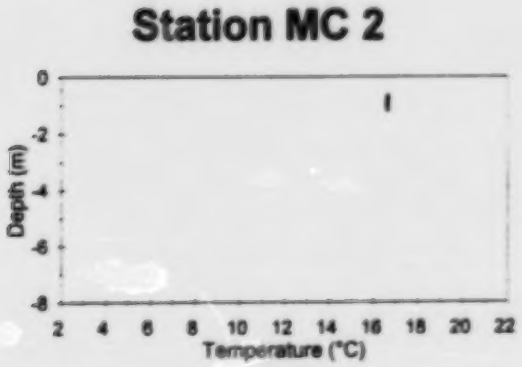


Figure A23. Temperature profile at station RR15, 16 Sept. 1996.

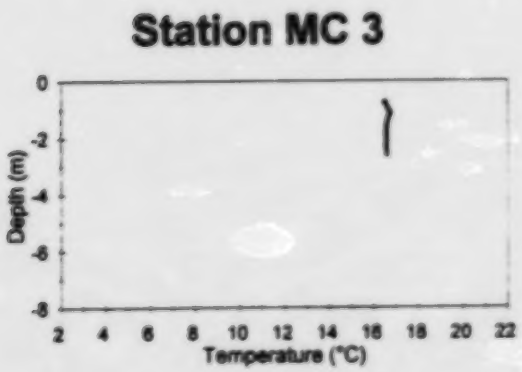
A24)



A25)

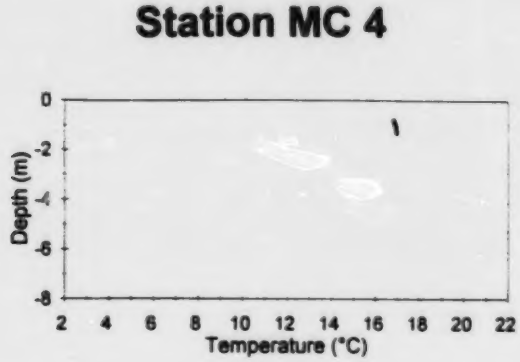


A26)

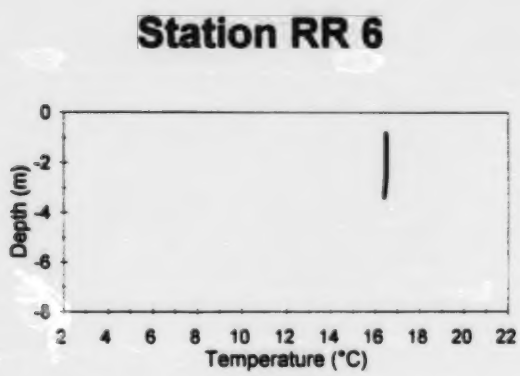


Figures A24, A25 and A26. Temperature profiles at stations MC1, MC2 and MC3, 18 Sept. 1996.

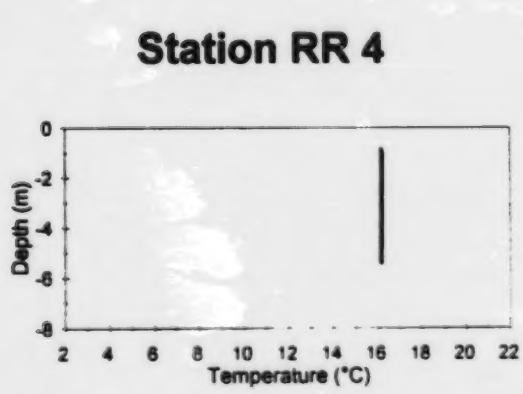
A27)



A28)



A29)



Figures A27, A28 and A29. Temperature profiles at stations MC4, RR6 and RR4, 18 Sept. 1996.

A30)

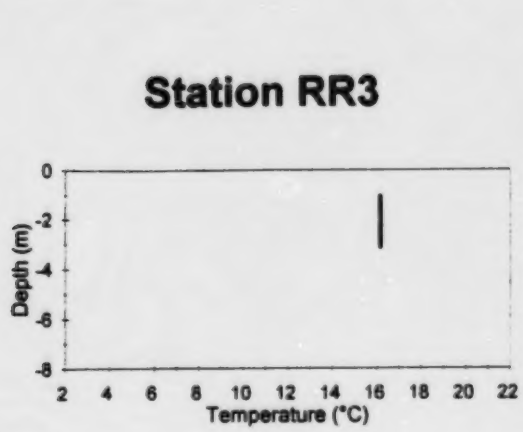
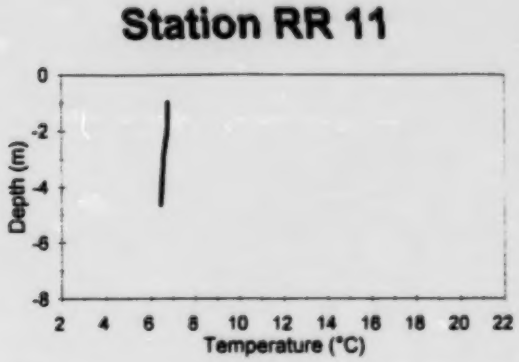
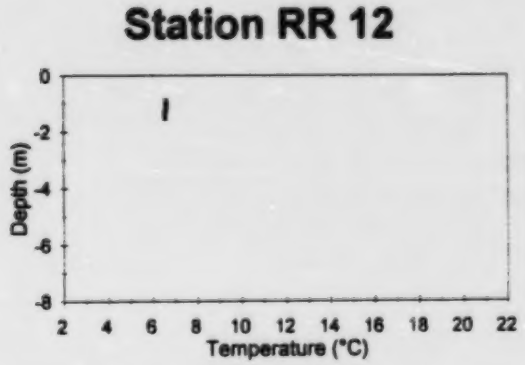


Figure A30. Temperature profile at station RR3, 18 Sept. 1996.

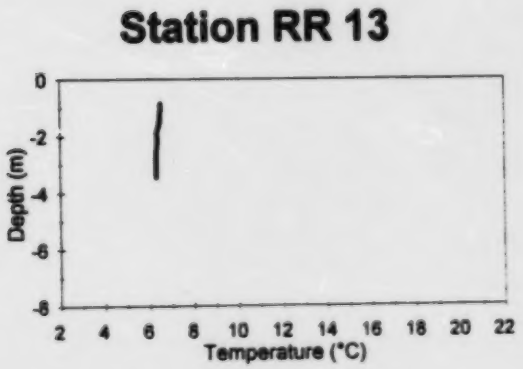
A31)



A32)

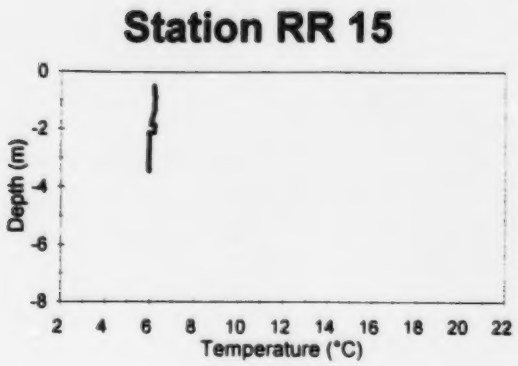


A33)

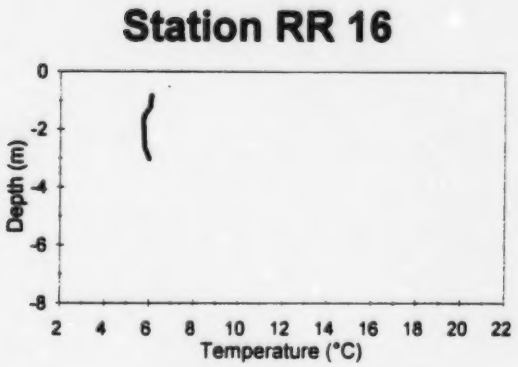


Figures A31, A32 and A33. Temperature profiles at stations RR11, RR12 and RR13, 18 Oct. 1996.

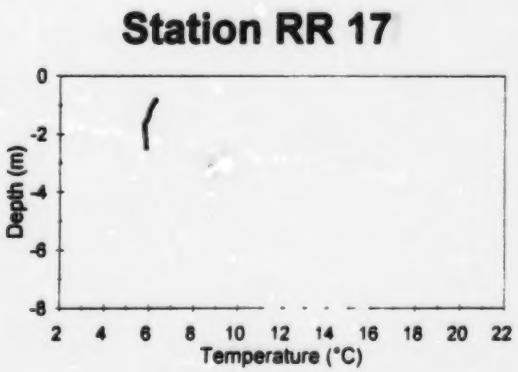
A34)



A35)

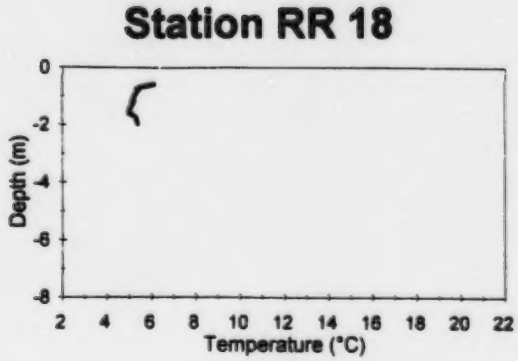


A36)

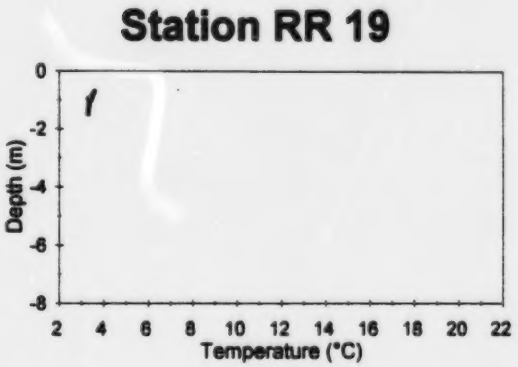


Figures A34, A35 and A36. Temperature profiles at stations RR15, RR16 and RR17, 18 Oct. 1996.

A37)

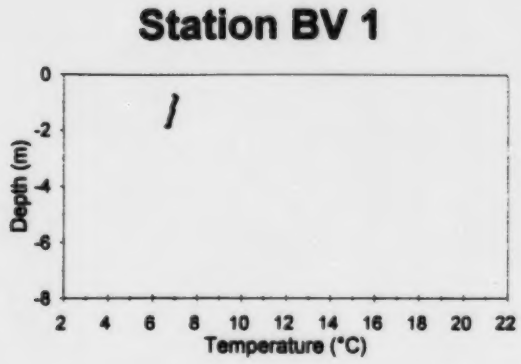


A38)

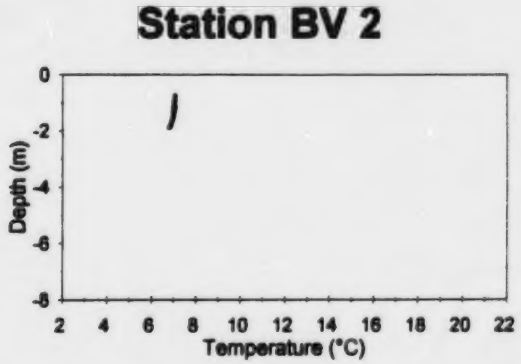


Figures A37 and A38. Temperature profiles at stations RR18 and RR19, 18 Oct. 1996.

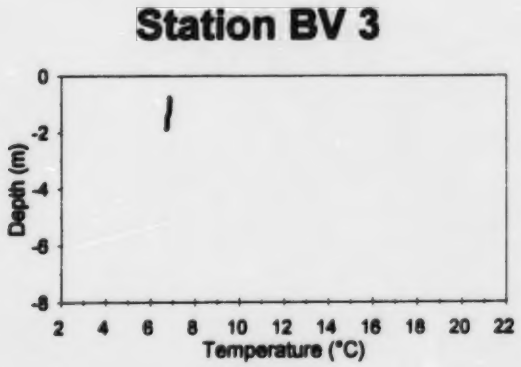
A39)



A40)

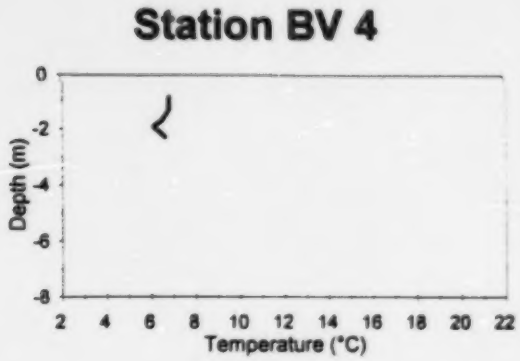


A41)

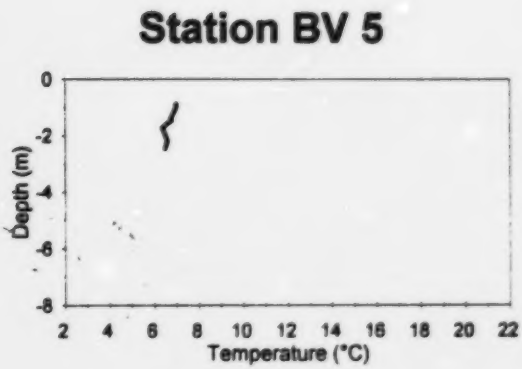


Figures A39, A40 and A41. Temperature profiles at stations BV1, BV2 and BV3, 21 Oct. 1996.

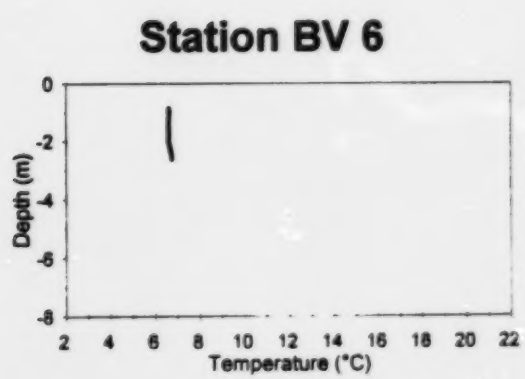
A42)



A43)

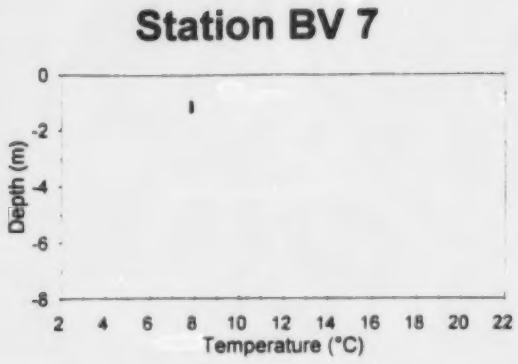


A44)

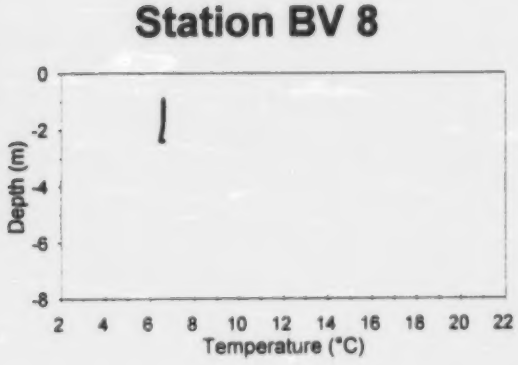


Figures A42, A43 and A44. Temperature profiles at stations BV4, BV5 and BV6, 21 Oct. 1996.

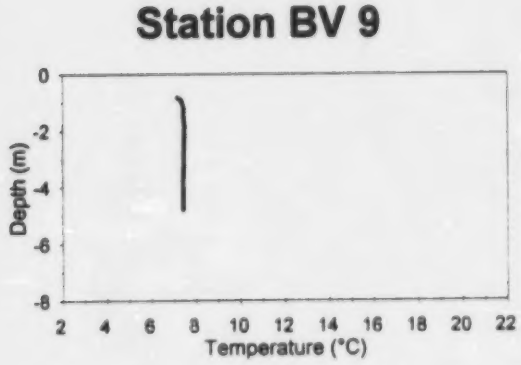
A45)



A46)

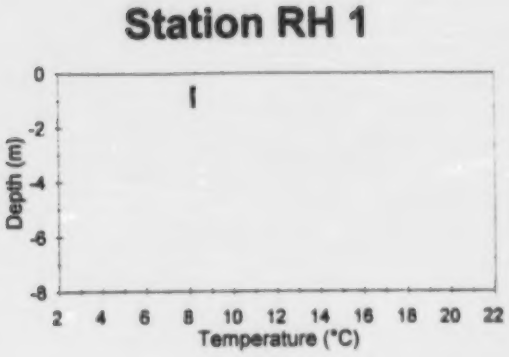


A47)

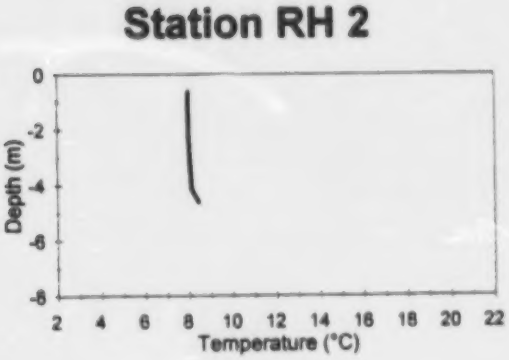


Figures A45, A46 and A47. Temperature profiles at stations BV7, BV8 and BV9, 21 Oct. 1996.

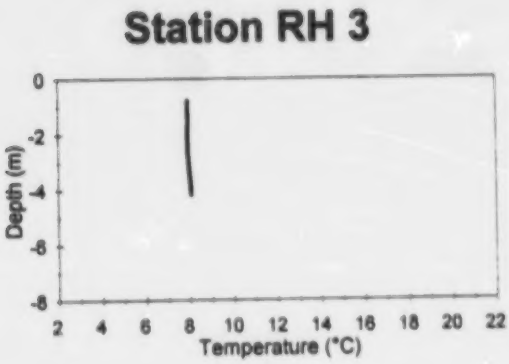
A48)



A49)

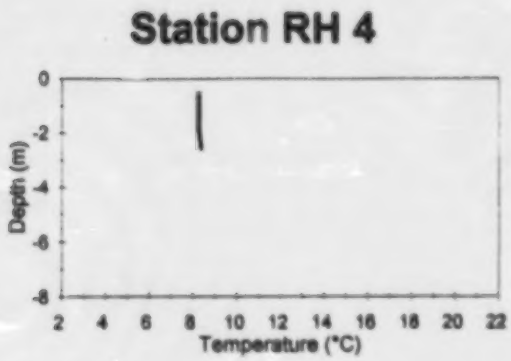


A50)

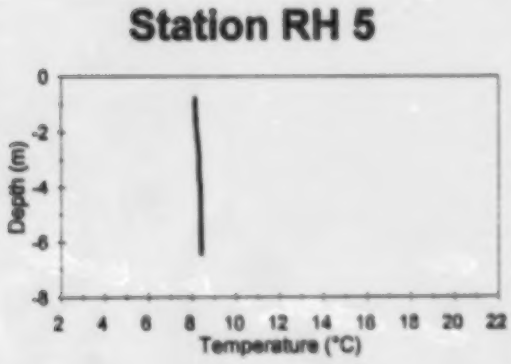


Figures A48, A49 and A50. Temperature profiles at stations RH1, RH2 and RH3, 24 Oct. 1996.

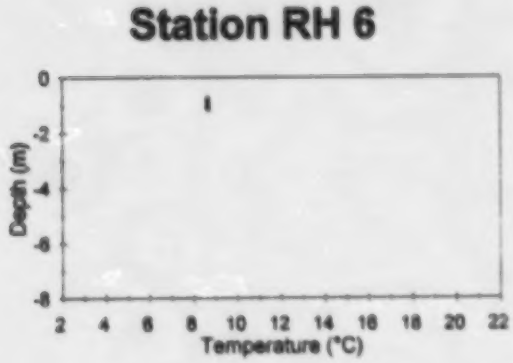
A51)



A52)

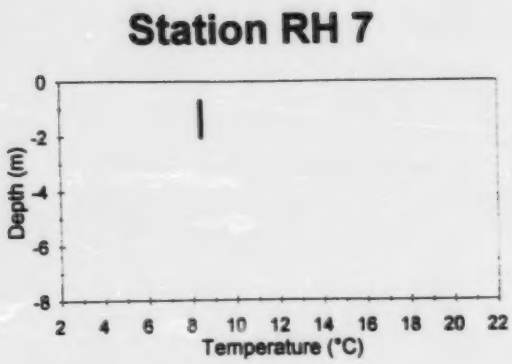


A53)

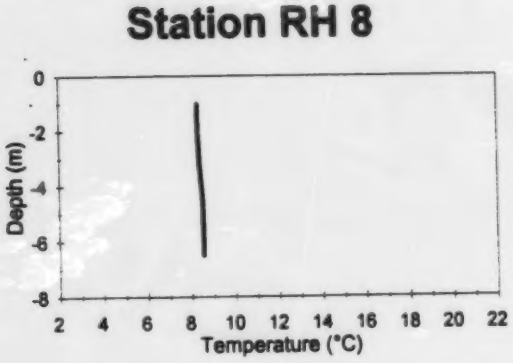


Figures A51, A52 and A53. Temperature profiles at stations RH4, RH5 and RH6, 24 Oct. 1998.

A54)

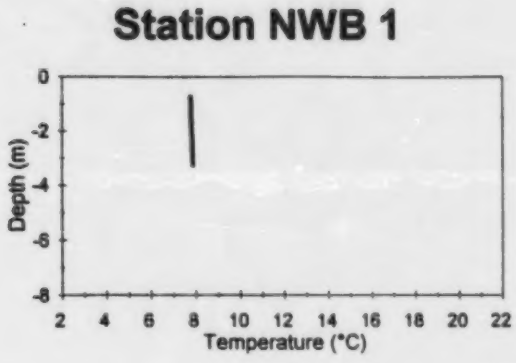


A55)

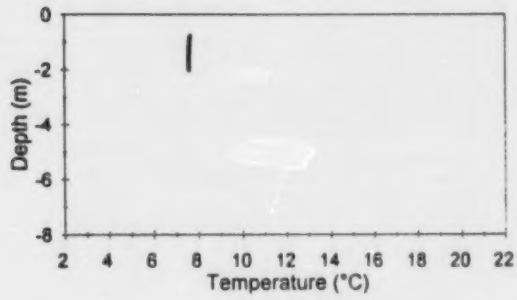


Figures A54and A55. Temperature profiles at stations RH7 and RH8, 24 Oct. 1996.

A56)


Station NWB 1
Depth (m)
0
-2
-4
-6
-8
2
4
6
8
10
12
14
16
18
20
22
Temperature (°C)

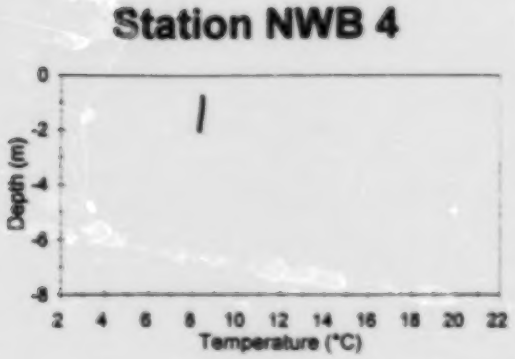
A57)


Station NWB 2
Depth (m)
0
-2
-4
-6
-8
2
4
6
8
10
12
14
16
18
20
22
Temperature (°C)

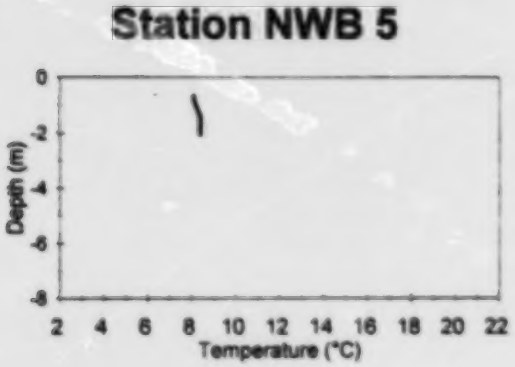
APPENDIX B

SALINITY PROFILES

A59)

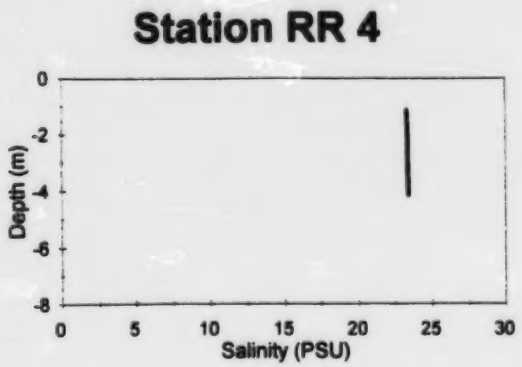


A60)

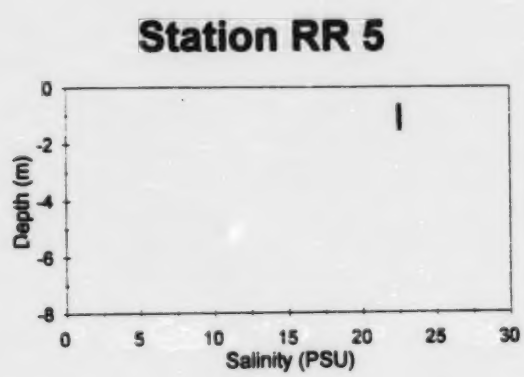


Figures A59 and A60. Temperature profiles at stations NWB4 and NWB5, 24 Oct. 1996.

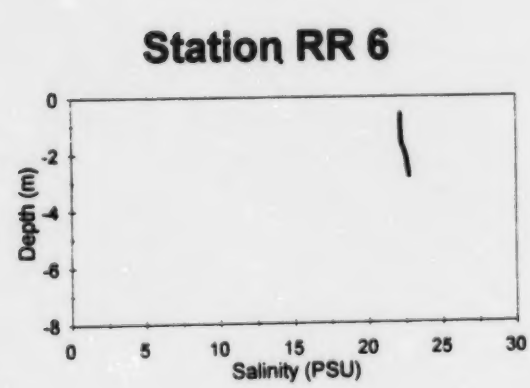
B1)



B2)

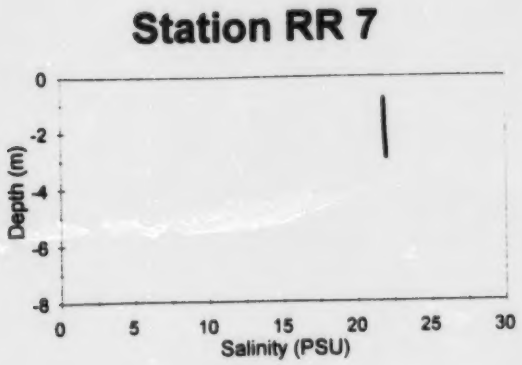


B3)

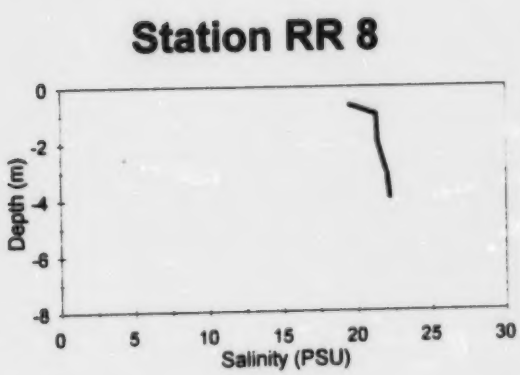


Figures B1, B2 and B3. Salinity profiles at stations RR4, RR5 and RR6, 9 Sept. 1996.

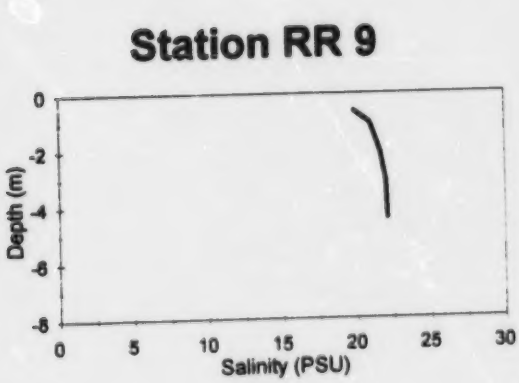
B4)



B5)



B6)



Figures B4, B5 and B6. Salinity profiles at stations RR7, RR8 and RR9, 9 Sept. 1996.

B7)

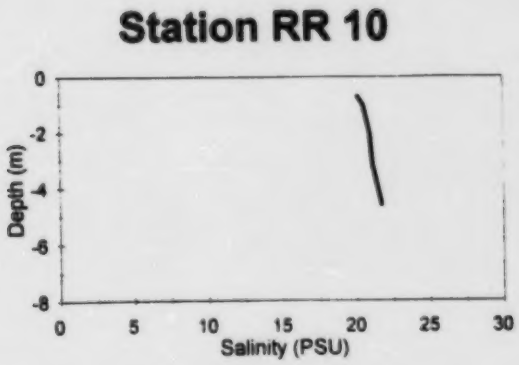
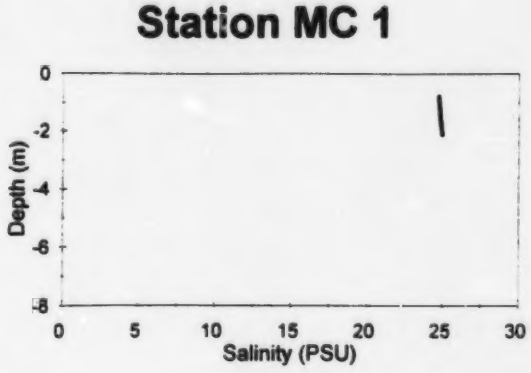
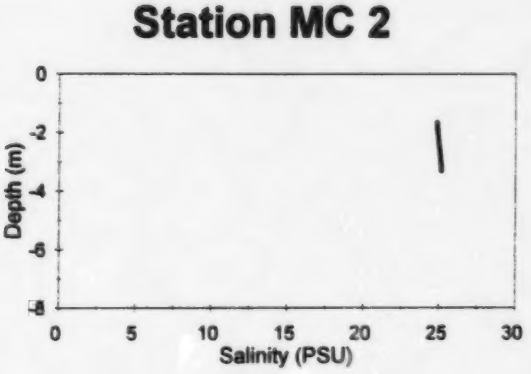


Figure B7. Salinity profile at station RR10, 9 Sept. 1996.

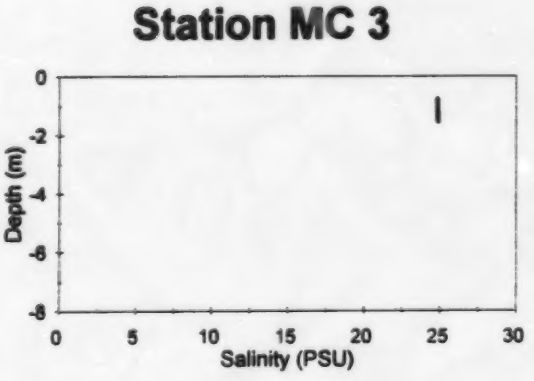
B8)



B9)

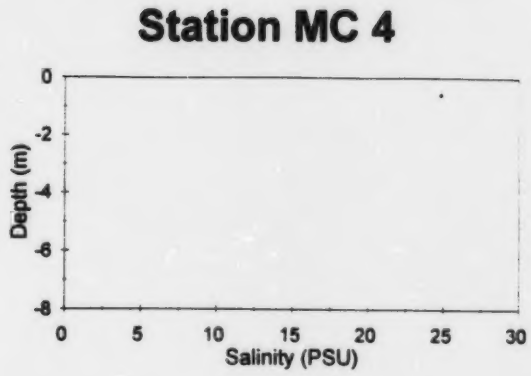


B10)

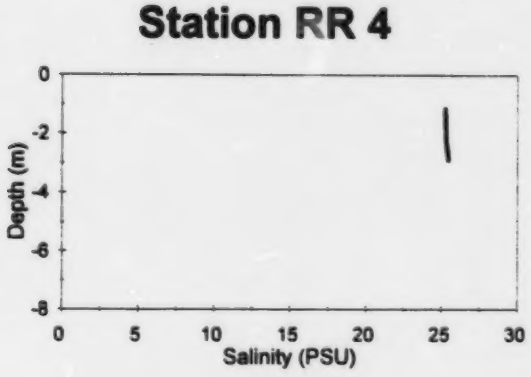


Figures B8, B9 and B10. Salinity profiles at stations MC1, MC2 and MC3, 12 Sept. 1996.

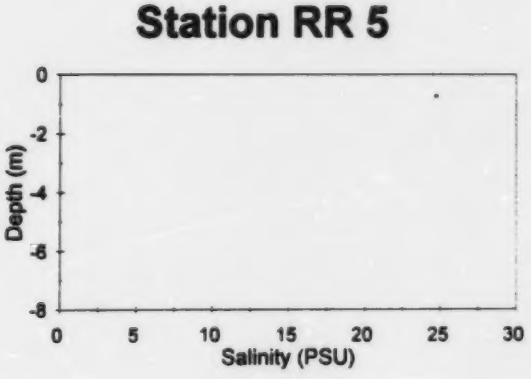
B11)



B12)

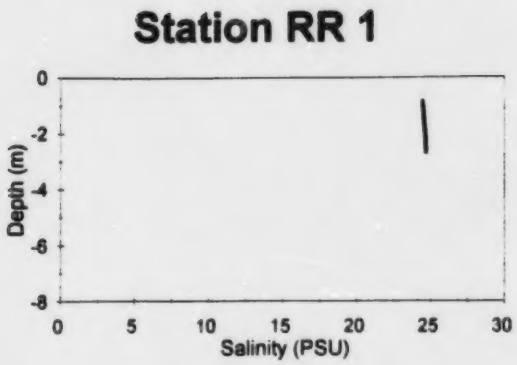


B13)

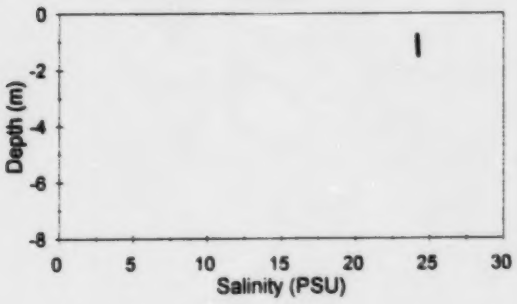


Figures B11, B12 and B13. Salinity profiles at stations MC4, RR4 and RR5, 12 Sept. 1996.

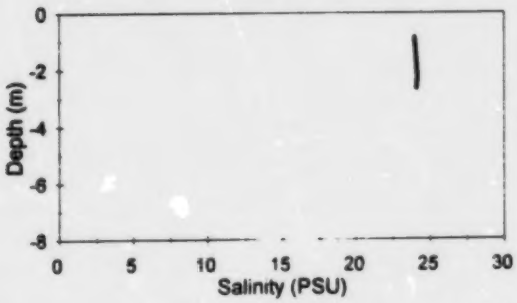
B14)



B15)

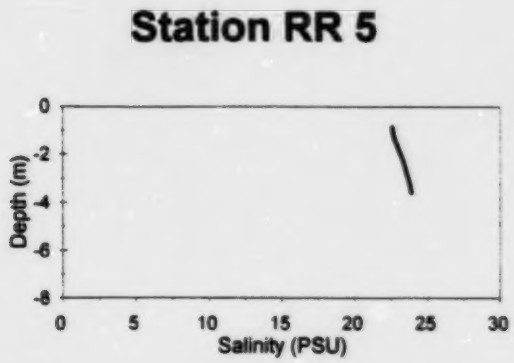


B16)

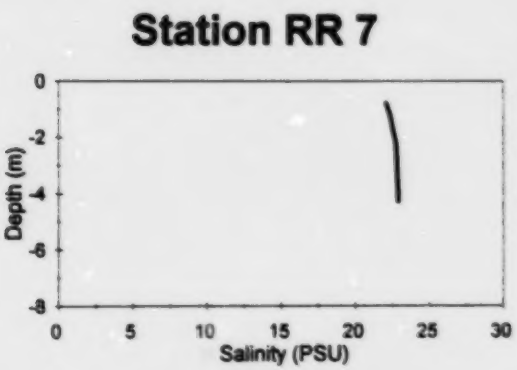


Figures B14, B15 and B16. Salinity profiles at stations RR1, RR3 and RR4, 16 Sept. 1996.

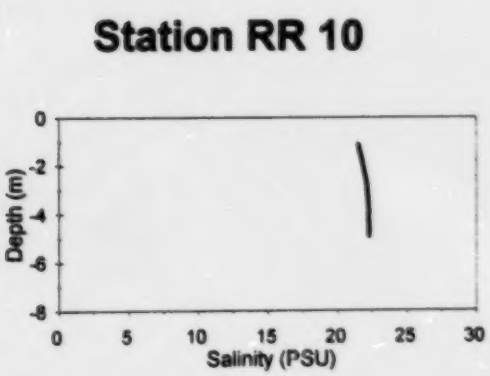
B17)



B18)

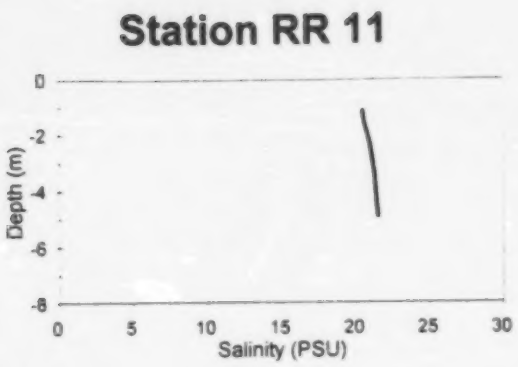


B19)

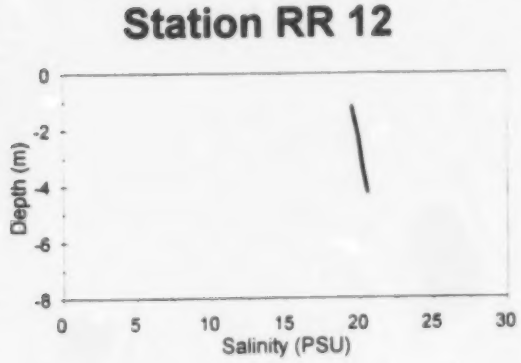


Figures B17, B18 and B19. Salinity profiles at stations RR5, RR7 and RR10, 16 Sept. 1998.

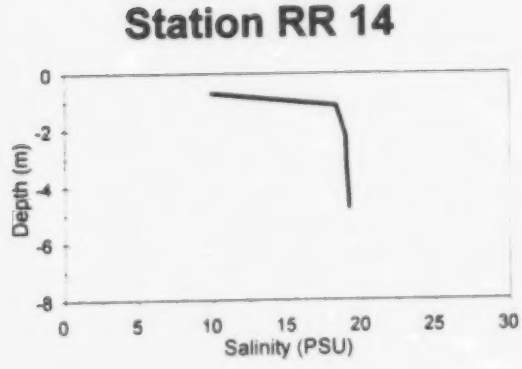
B20)



B21)



B22)



Figures B20, B21 and B22. Salinity profiles at stations RR11, RR12 and RR14, 16 Sept. 1996.

B23)

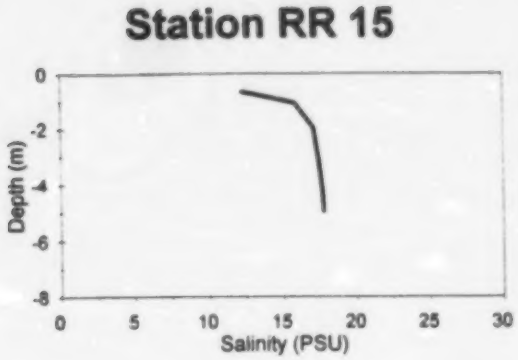
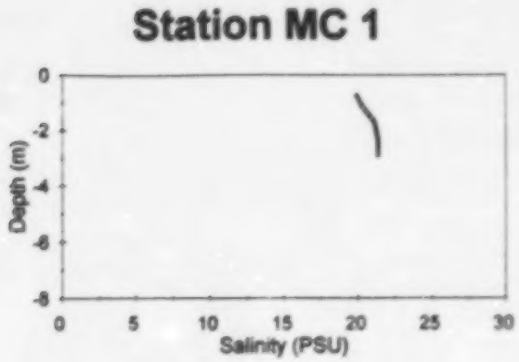
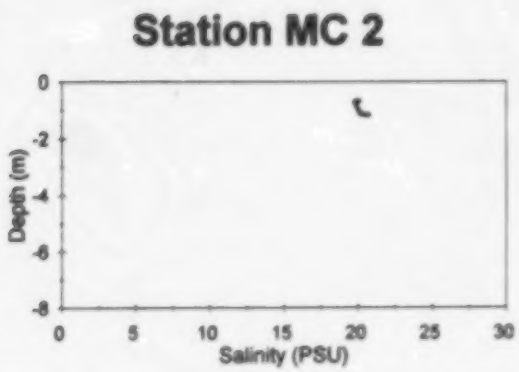


Figure B23. Salinity profile at station RR15, 16 Sept. 1996.

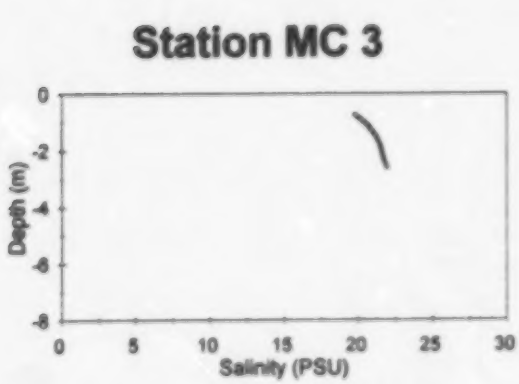
B24)



B25)

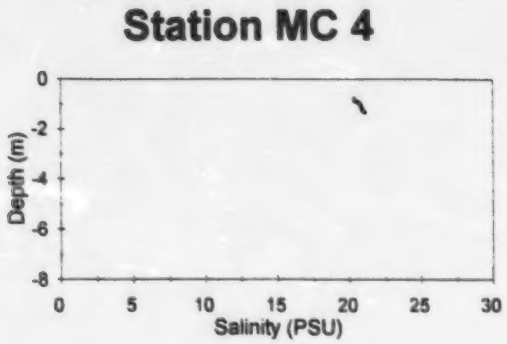


B26)

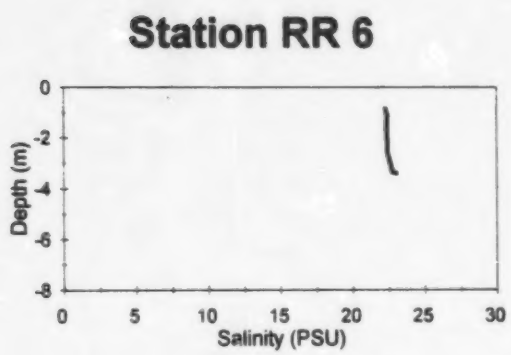


Figures B24, B25 and B26. Salinity profiles at stations MC1, MC2 and MC3, 18 Sept. 1996.

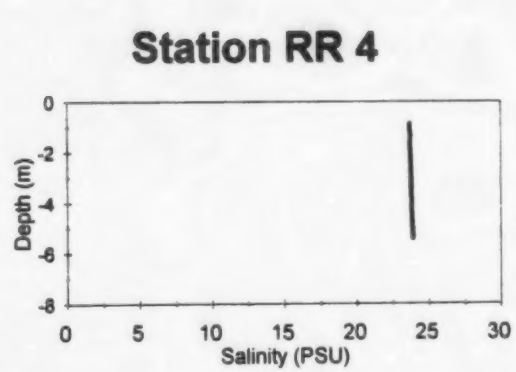
B27)



B28)



B29)



Figures B27, B28 and B29. Salinity profiles at stations MC4, RR6 and RR4, 18 Sept. 1996.

B30)

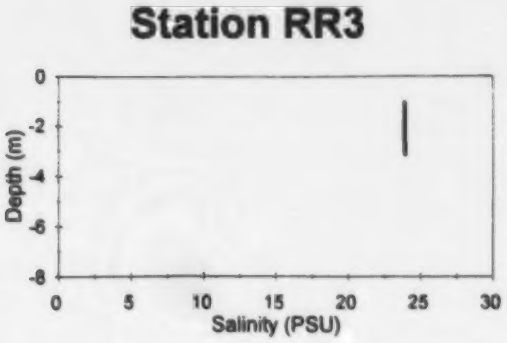
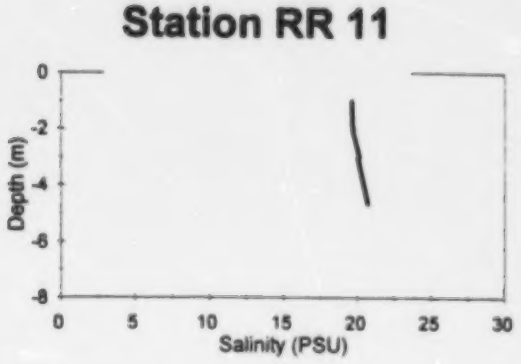
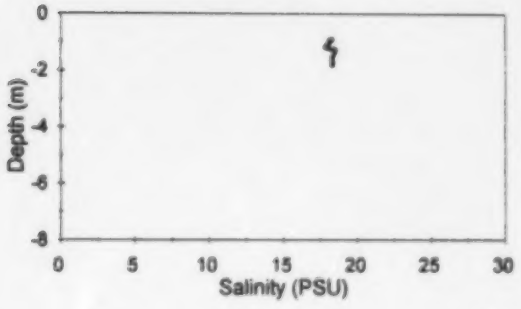


Figure B30. Salinity profile at station RR3, 18 Sept. 1996.

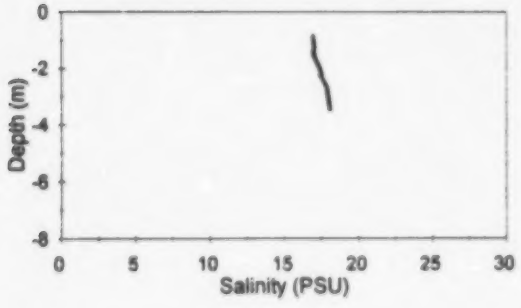
B31)



B32)

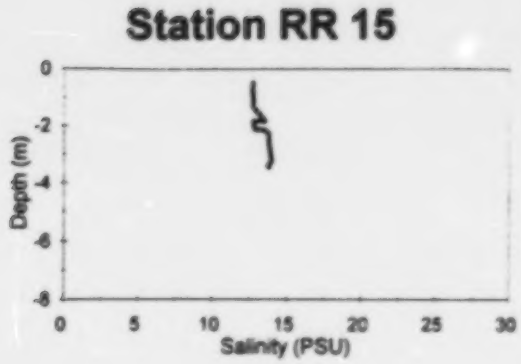


B33)

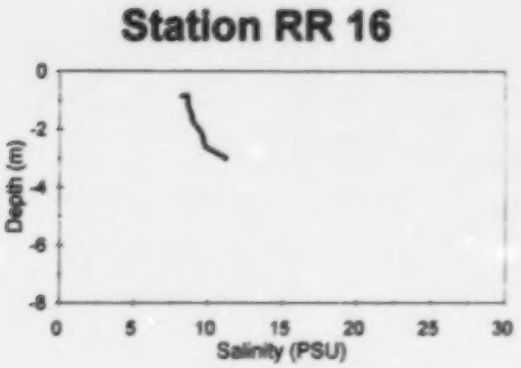


Figures B31, B32 and B33. Salinity profiles at stations RR11, RR12 and RR13, 18 Oct. 1996.

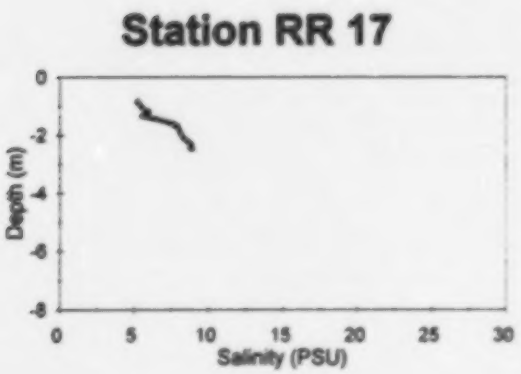
B34)



B35)

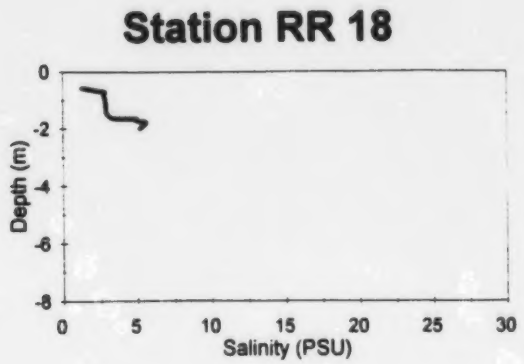


B36)

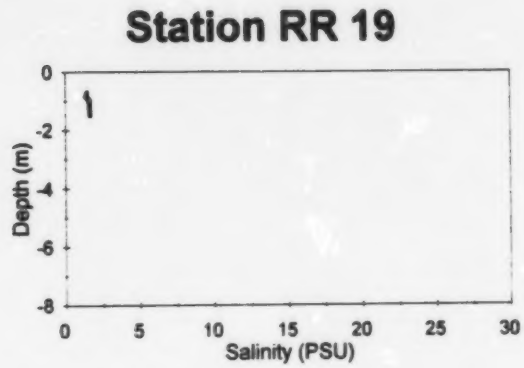


Figures B34, B35 and B36. Salinity profiles at stations RR15, RR16 and RR17, 18 Oct. 1996.

B37)

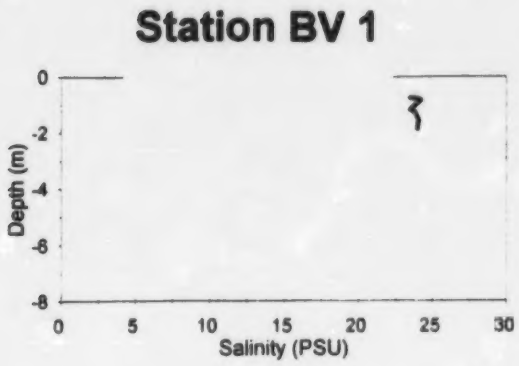


B38)

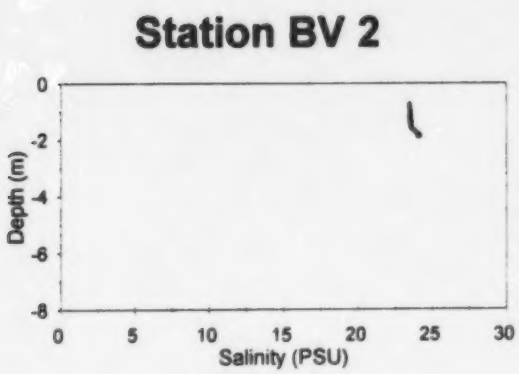


Figures B37 and B38. Salinity profiles at stations RR18 and RR19, 18 Oct. 1996.

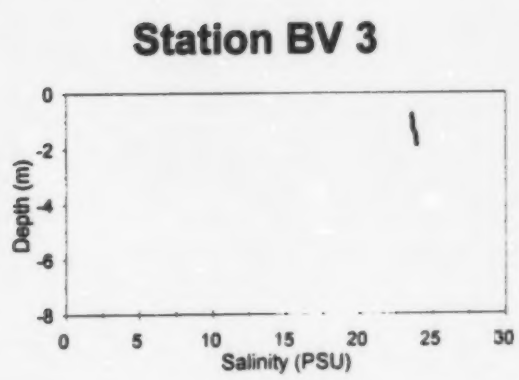
B39)



B40)

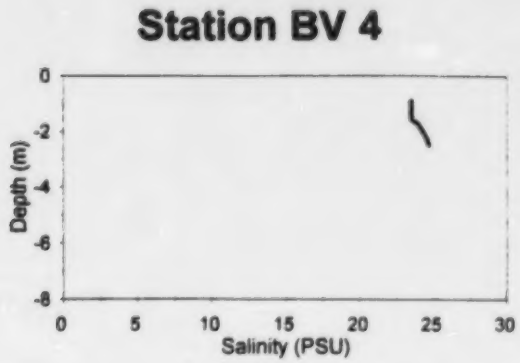


B41)

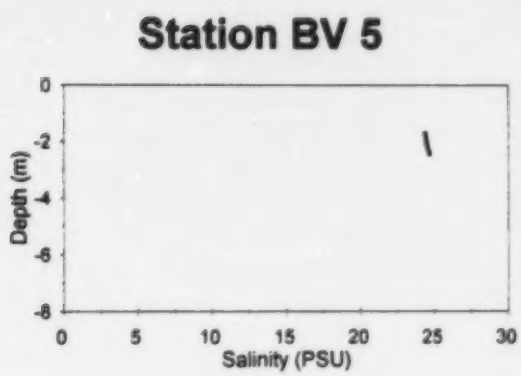


Figures B39, B40 and B41. Salinity profiles at stations BV1, BV2 and BV3, 21 Oct. 1996.

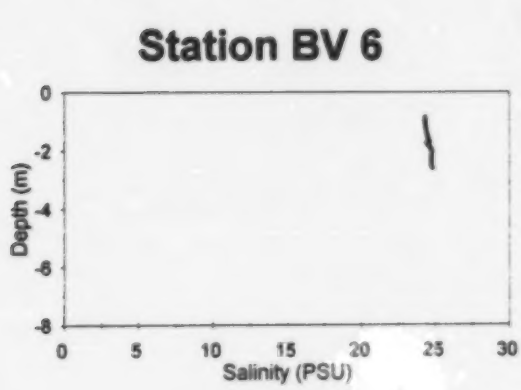
B42)



B43)

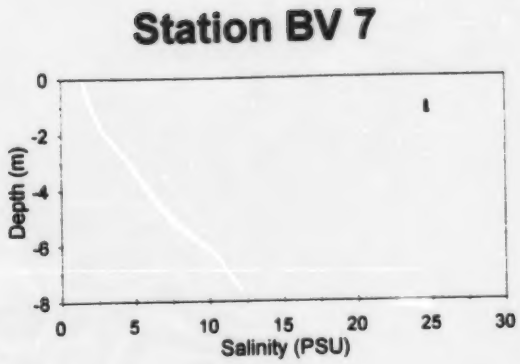


B44)

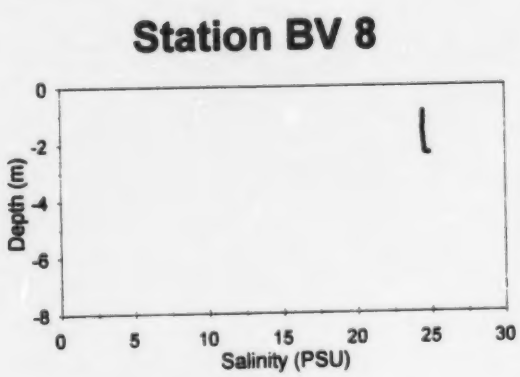


Figures B42, B43 and B44. Salinity profiles at stations BV4, BV5 and BV6, 21 Oct. 1996.

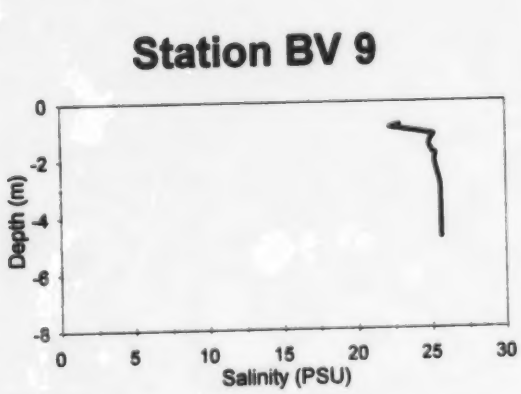
B45)



B46)

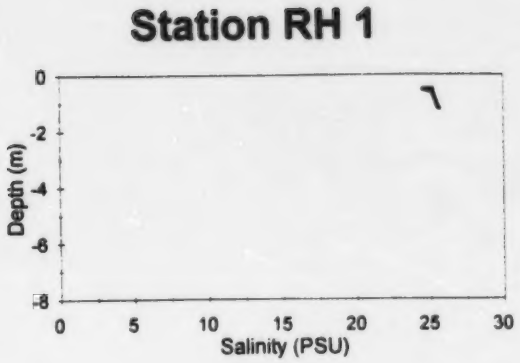


B47)



Figures B45, B46 and B47. Salinity profiles at stations BV7, BV8 and BV9, 21 Oct. 1996.

B48)



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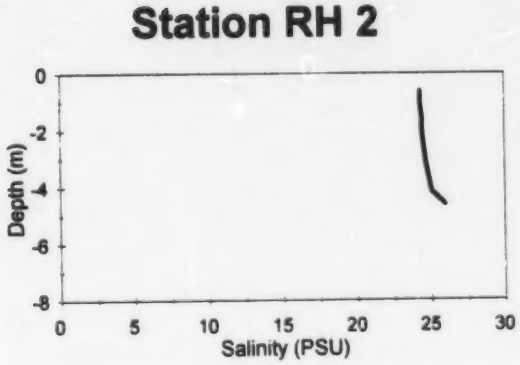
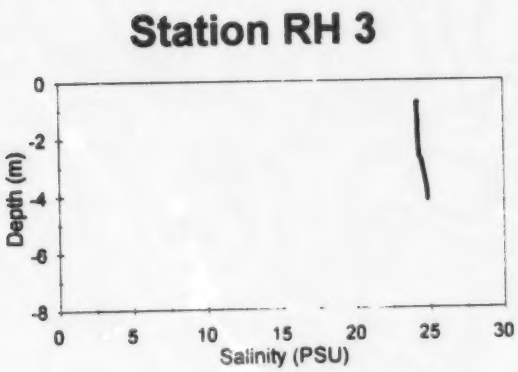
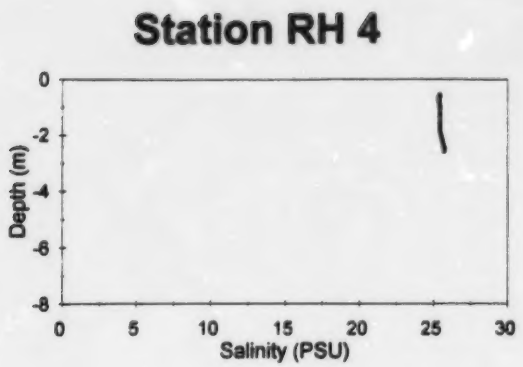


B50)

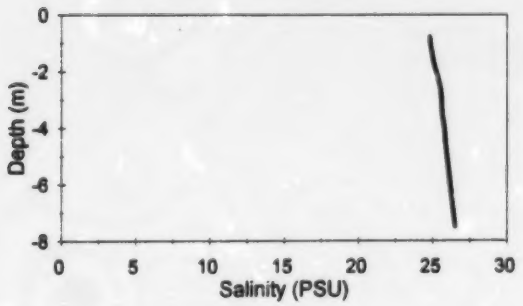


Figures B48, B49 and B50. Salinity profiles at stations RH1, RH2 and RH3, 24 Oct. 1996.

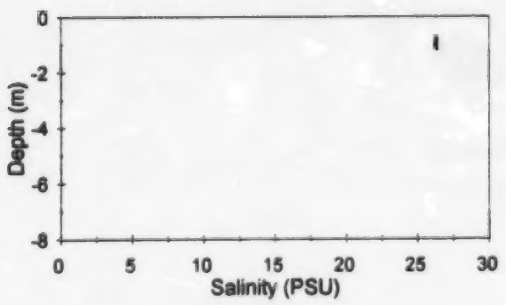
B51)



B52)

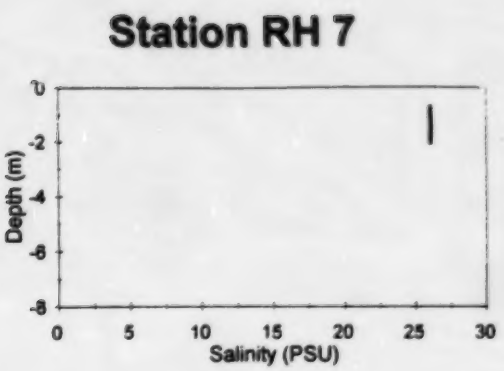


B53)

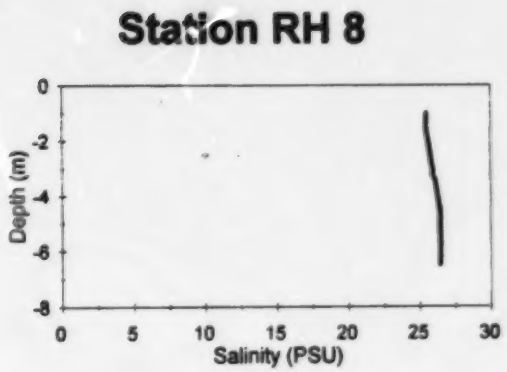


Figures B51, B52 and B53. Salinity profiles at stat RH4, RH5 and RH6, 24 Oct. 1996.

B54)

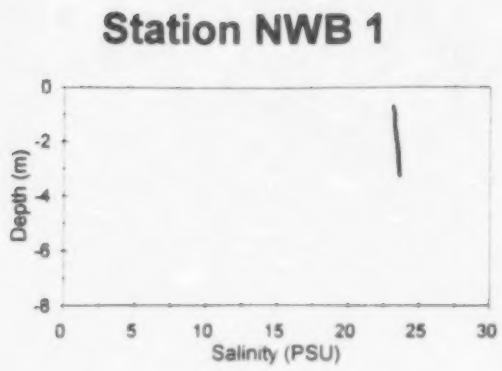


B55)

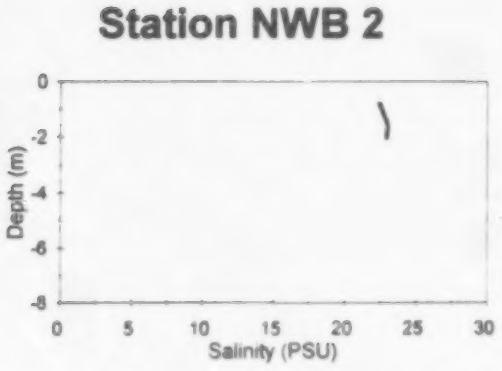


Figures B54 and B55. Salinity profiles at stations RH7 and RH8, 24 Oct. 1996.

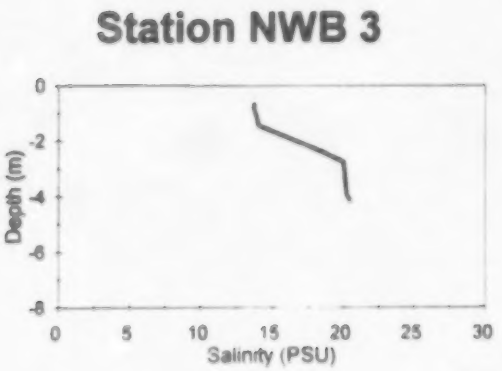
B56)



B57)

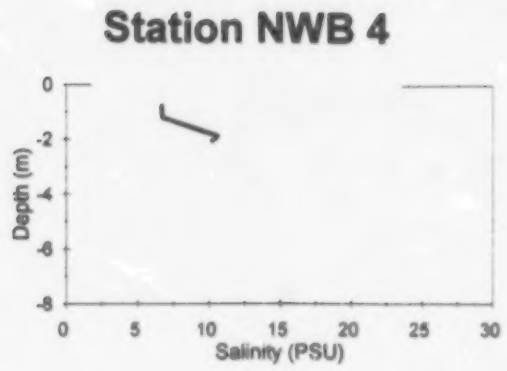


B58)

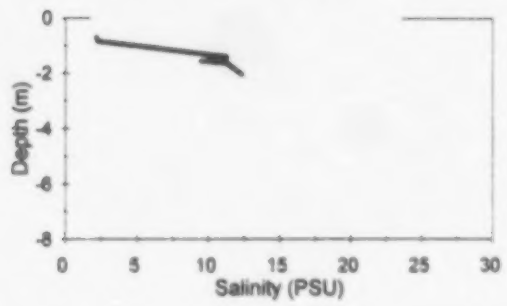


Figures B56, B57 and B58. Salinity profiles at stations NWB1, NWB2 and NWB3, 24 Oct. 1996.

B59)



B60)

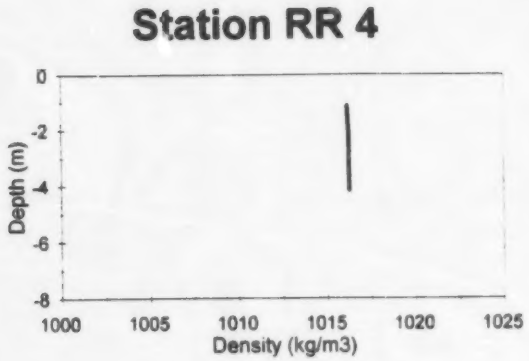


Figures B59 and B60. Salinity profiles at stations NWB4 and NWB5, 24 Oct. 1996.

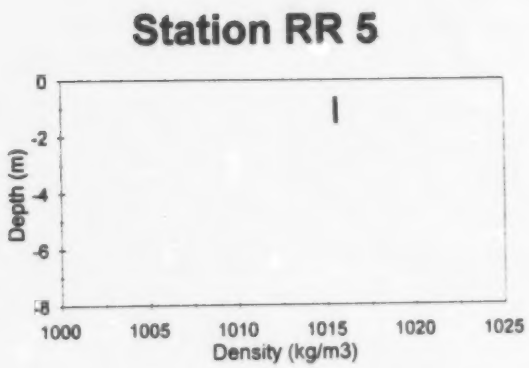
APPENDIX C

DENSITY PROFILES

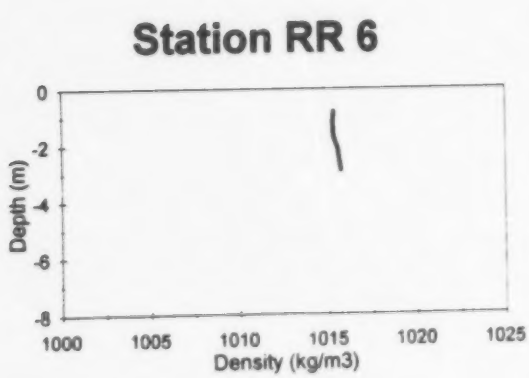
C1)



C2)

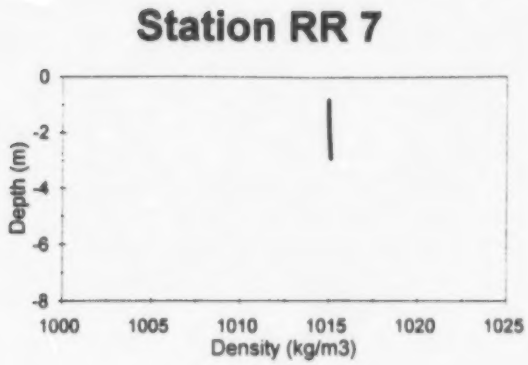


C3)

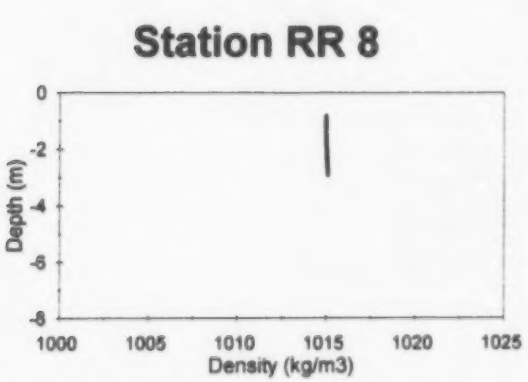


Figures C1, C2 and C3. Density profiles at stations RR4, RR5 and RR6, 9 Sept. 1996.

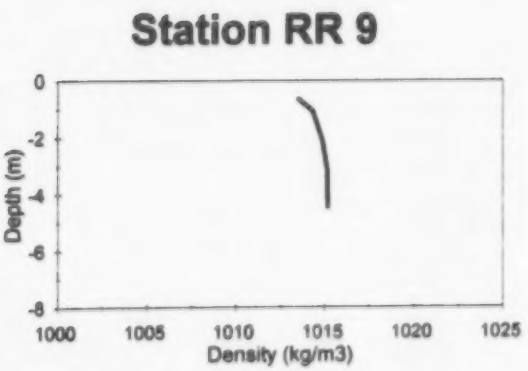
C4)



C5)



C6)



Figures C4, C5 and C6. Density profiles at stations RR7, RR8 and RR9, 9 Sept. 1996.

C7)

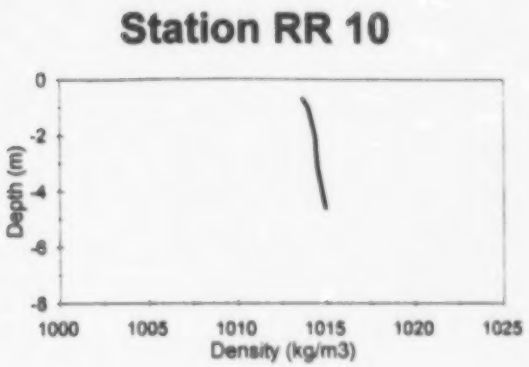
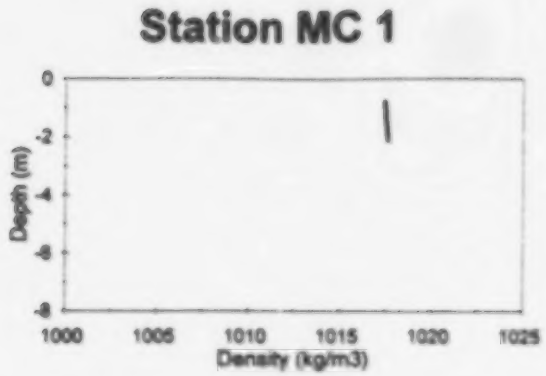
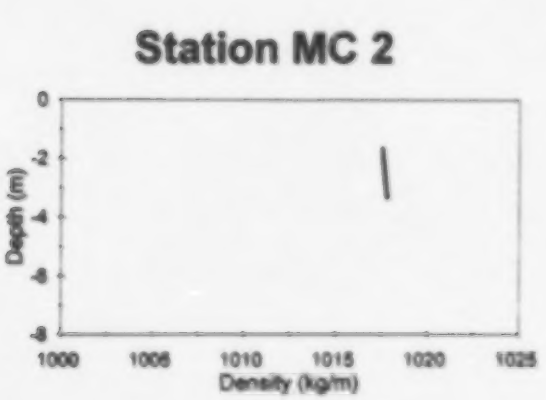


Figure C7. Density profile at station RR10, 9 Sept. 1996.

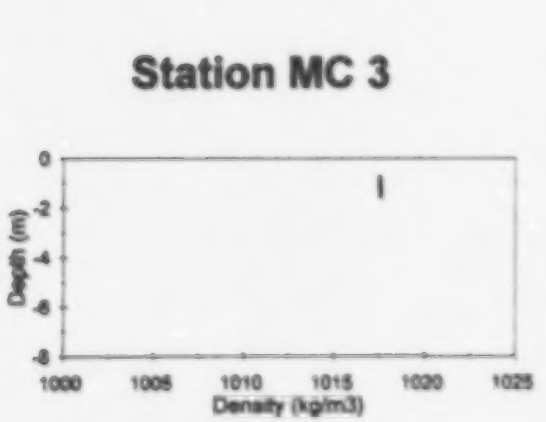
C8)



C9)

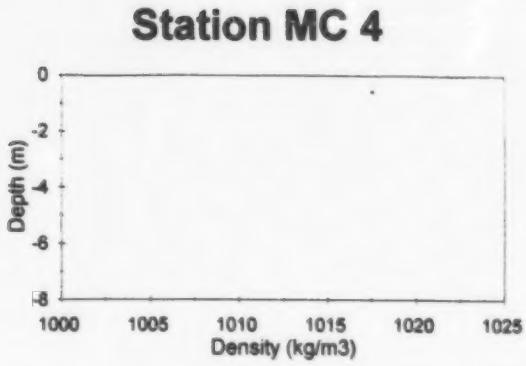


C10)

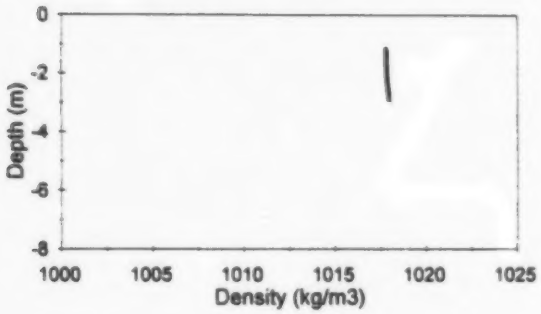


Figures C8, C9 and C10. Density profiles at stations MC1, MC2 and MC3, 12 Sept. 1996.

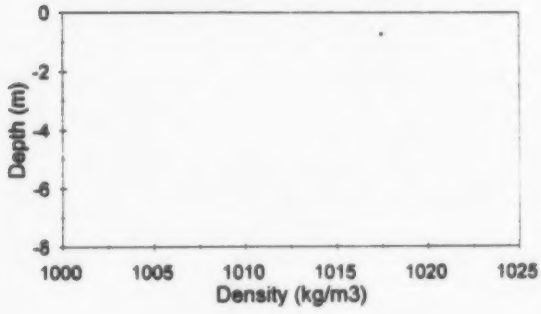
C11)



C12)

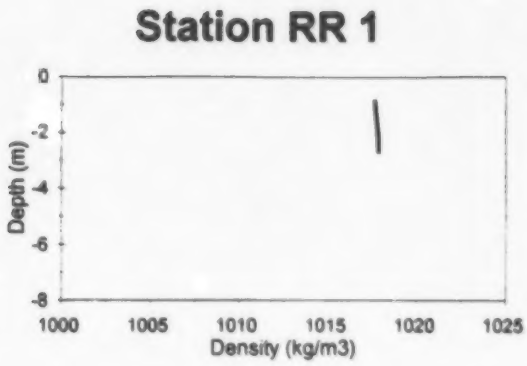


C13)

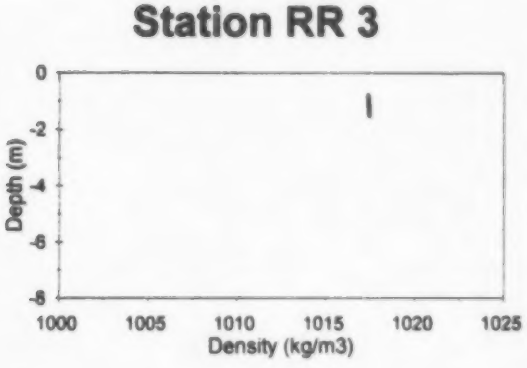


Figures C11, C12 and C13. Density profiles at stations MC4, RR4 and RR5, 12 Sept. 1996.

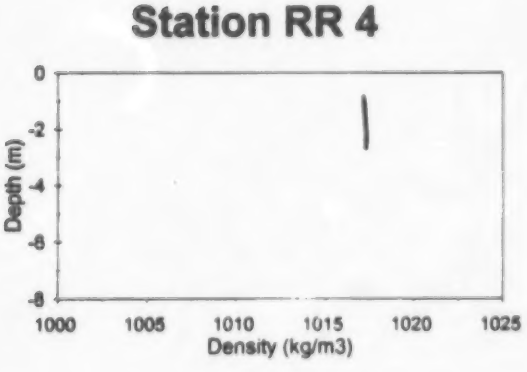
C14)



C15)

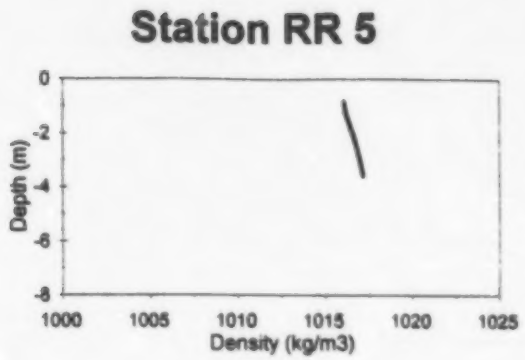


C16)

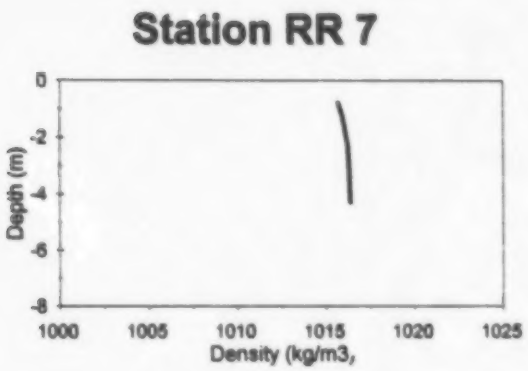


Figures C14, C15 and C16. Density profiles at stations RR1, RR3 and RR4, 16 Sept. 1996.

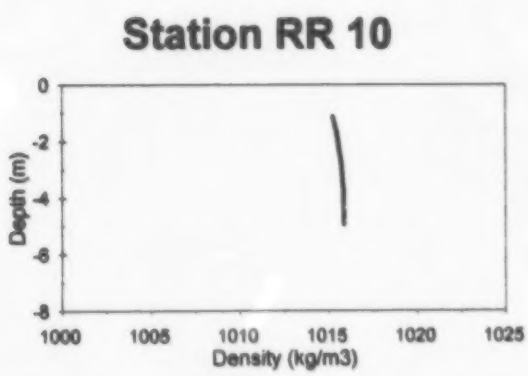
C17)



C18)

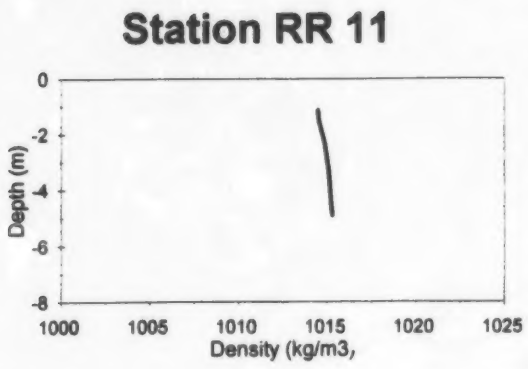


C19)

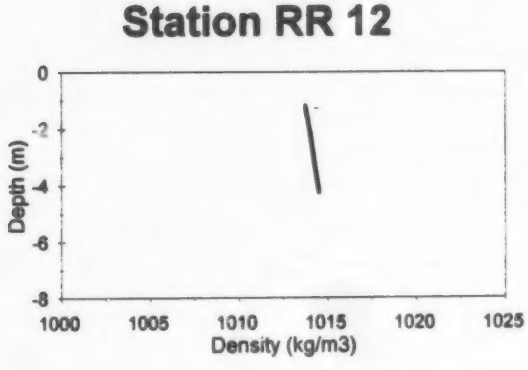


Figures C17, C18 and C19. Density profiles at stations RR5, RR7 and RR10, 16 Sept. 1996.

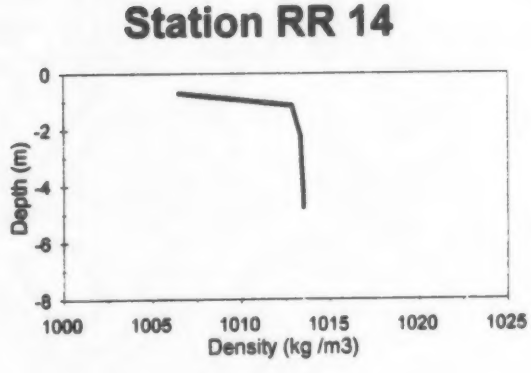
C20)



C21)



C22)



Figures C20, C21 and C22. Density profiles at stations RR11, RR12 and RR14, 16 Sept. 1996.

C23)

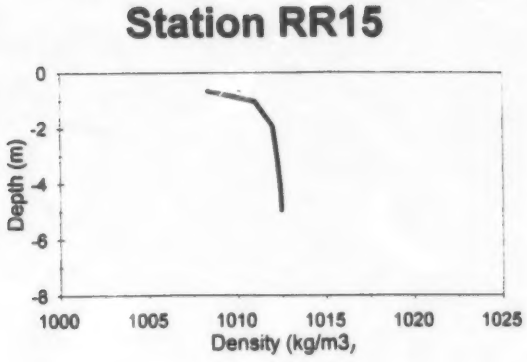
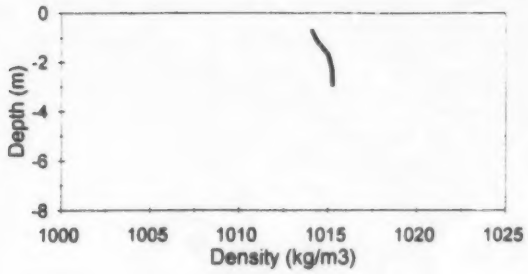


Figure C23. Density profile at station RR15, 16 Sept. 1996.

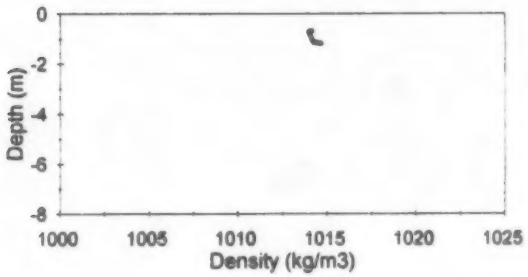
C24)

Station MC 1



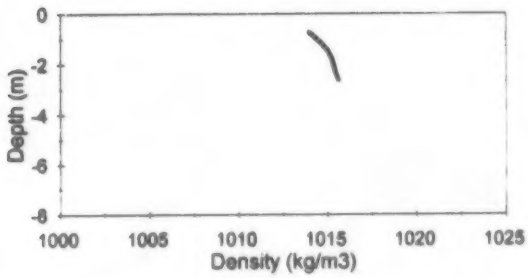
C25)

Station MC 2



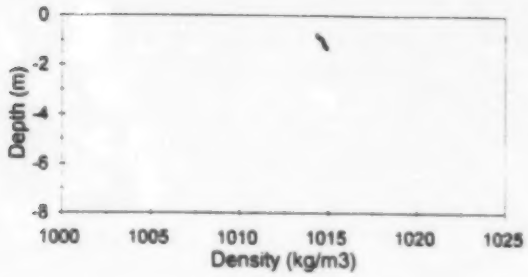
C26)

Station MC 3

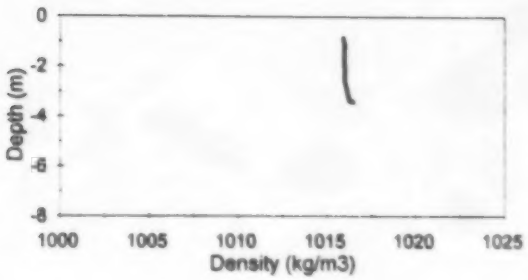


Figures C24, C25 and C26. Density profiles at stations MC1, MC2 and MC3, 18 Sept. 1996.

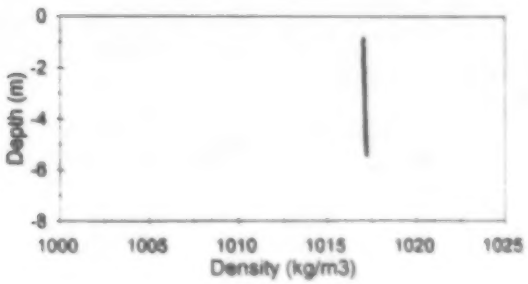
C27)



C28)



C29)



Figures C27, C28 and C29. Density profiles at stations MC4, RR6 and RR4, 18 Sept. 1996.

C30)

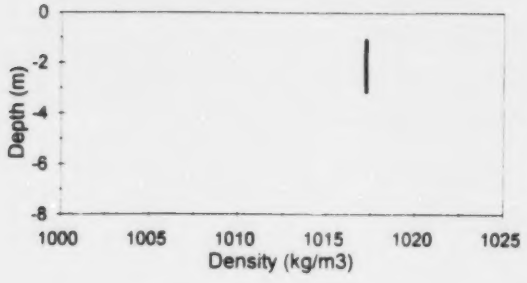
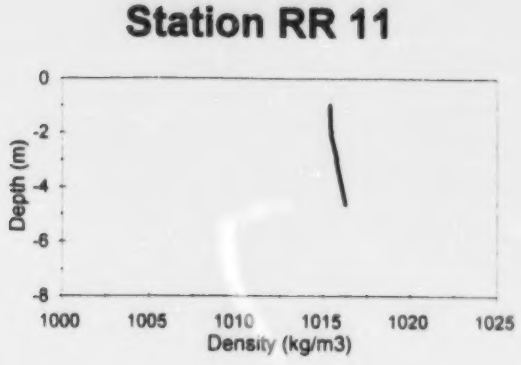
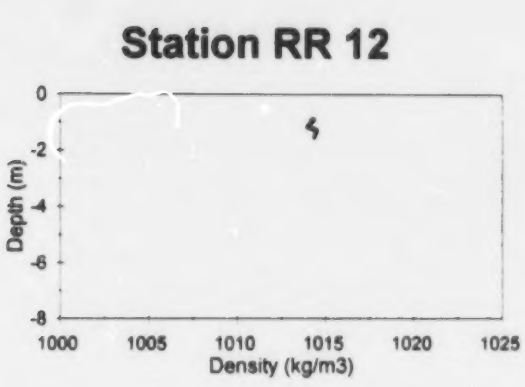


Figure C30. Density profile at station RR3, 18 Sept. 1996.

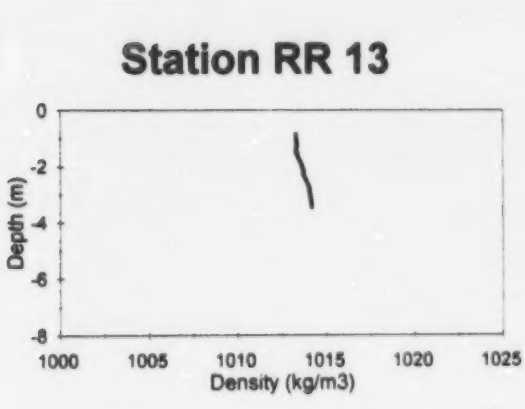
C31)



C32)

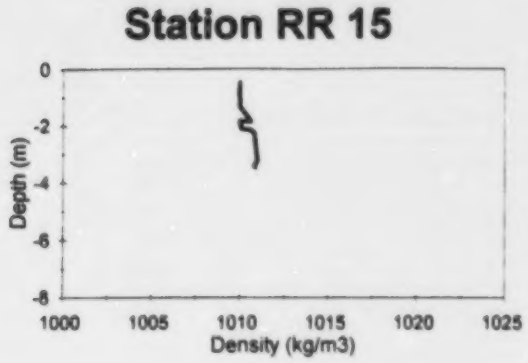


C33)

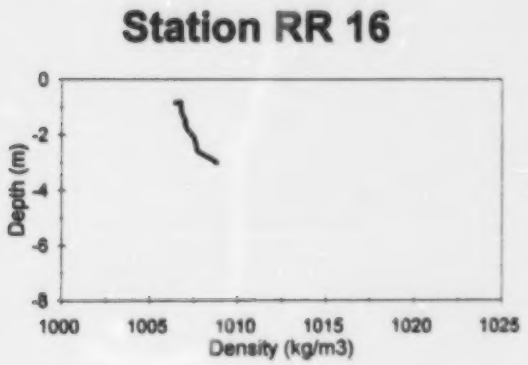


Figures C31, C32 and C33. Density profiles at stations RR11, RR12 and RR13, 18 Oct. 1996.

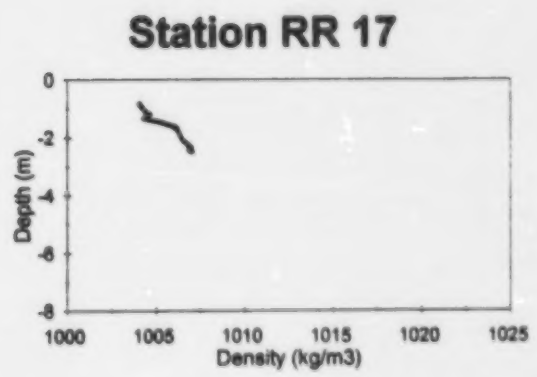
C34)



C35)

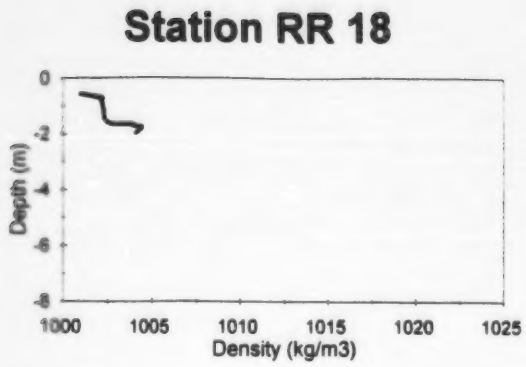


C36)

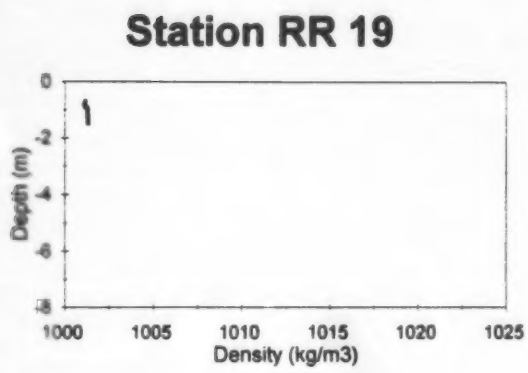


Figures C34, C35 and C36. Density profiles at stations RR15, RR16 and RR17, 18 Oct. 1996.

C37)

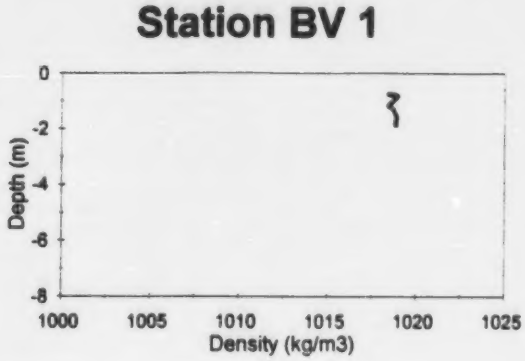


C38)

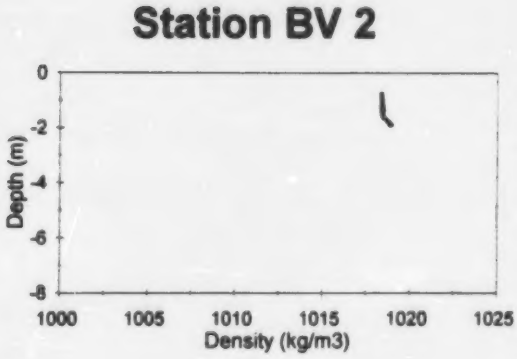


Figures C37 and C38. Density profiles at stations RR18 and RR19, 18 Oct. 1996.

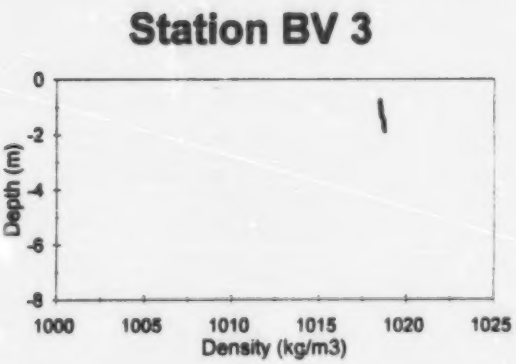
C39)



C40)

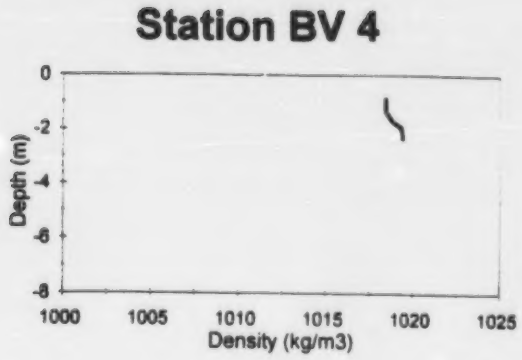


C41)

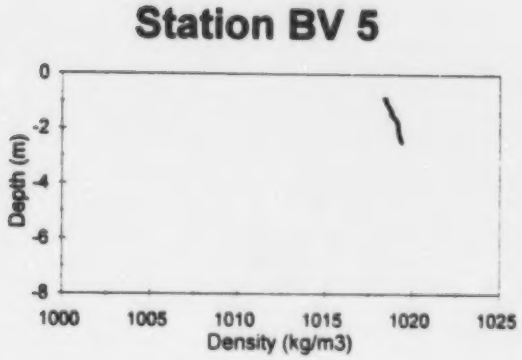


Figures C39, C40 and C41. Density profiles at stations BV1, BV2 and BV3, 21 Oct. 1996.

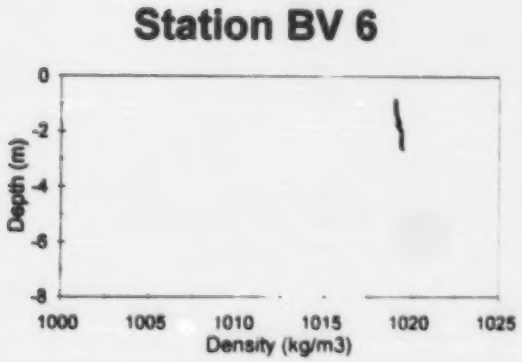
C42)



C43)

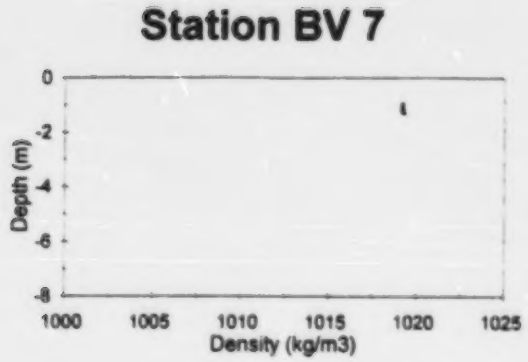


C44)

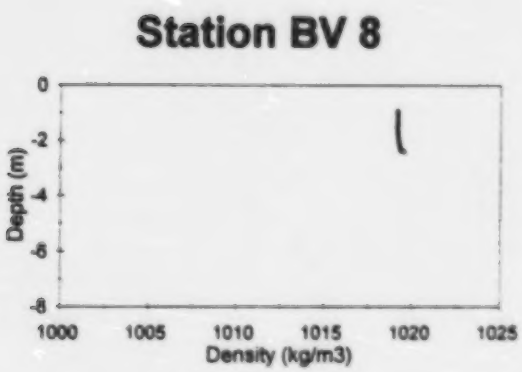


Figures C42, C43 and C44. Density profiles at stations BV4, BV5 and BV6, 21 Oct. 1996.

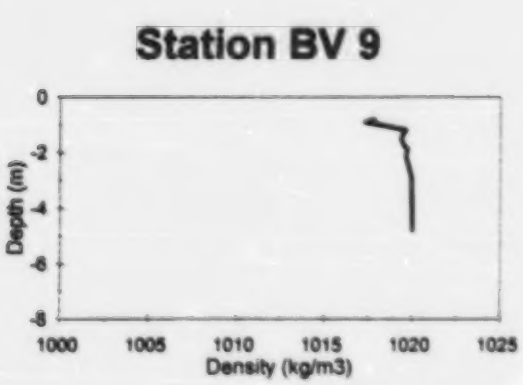
C45)



C46)

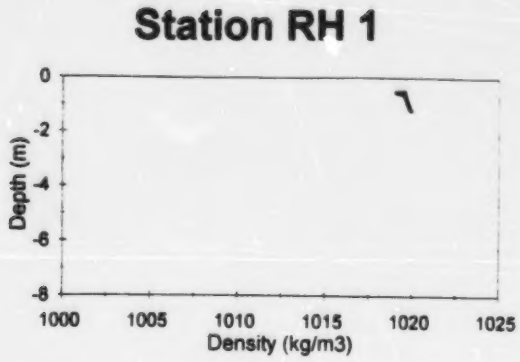


C47)

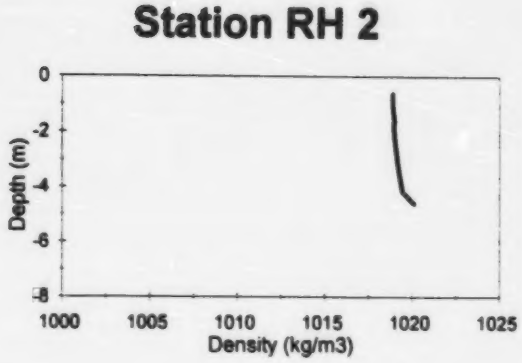


Figures C45, C46 and C47. Density profiles at stations BV7, BV8 and BV9, 21 Oct. 1996.

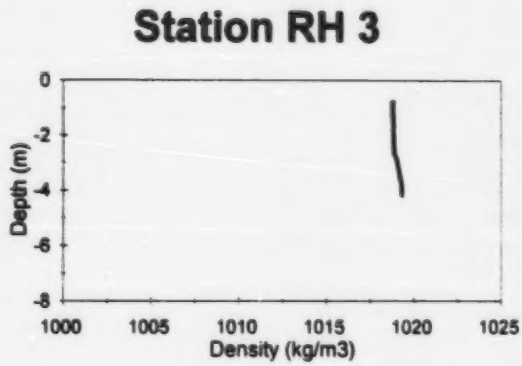
C48)



C49)

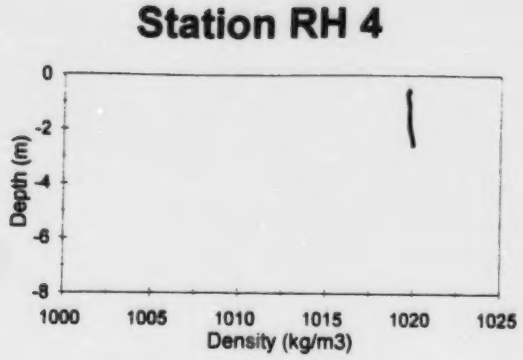


C50)

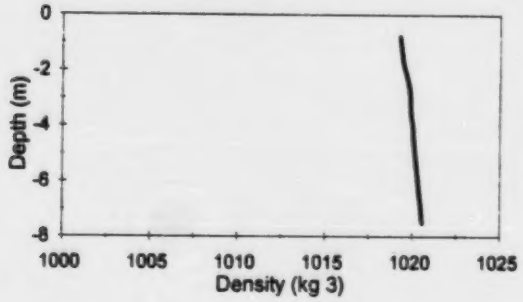


Figures C48, C49 and C50. Density profiles at stations RH1, RH2 and RH3, 24 Oct. 1996.

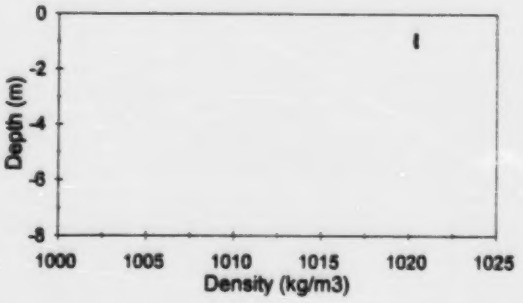
C51)



C52)

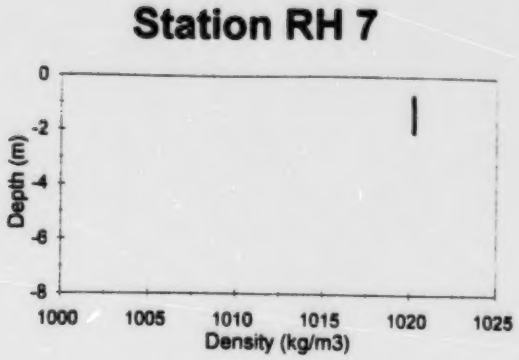


C53)

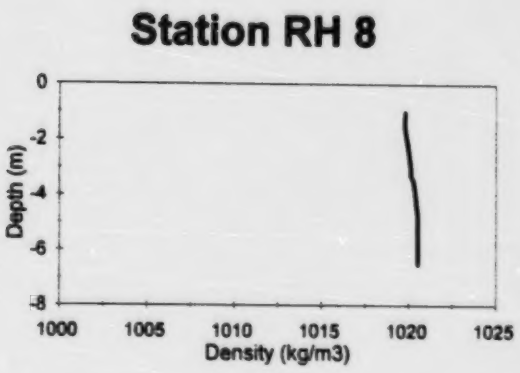


Figures C51, C52 and C53. Density profiles at stations RH4, RH5 and RH6, 24 Oct. 1996.

C54)

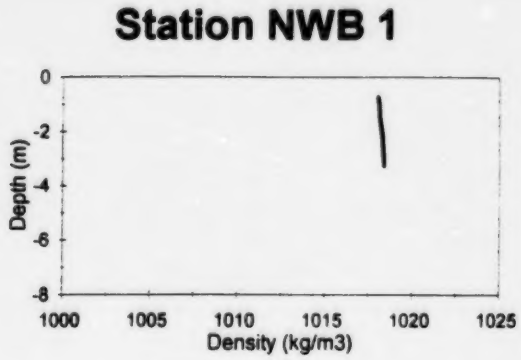


C55)

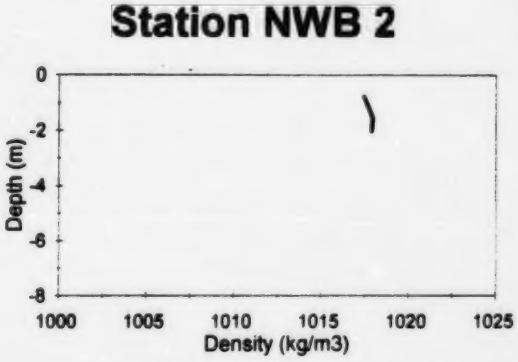


Figures C54 and C55. Density profiles at stations RH7 and RH8, 24 Oct. 1996.

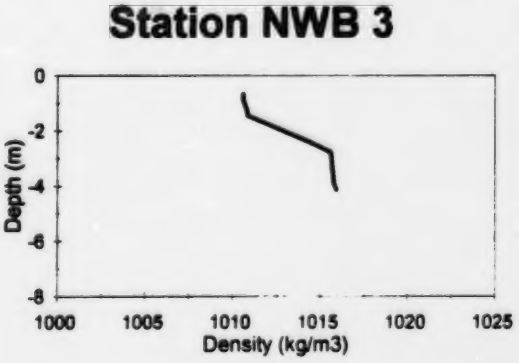
C56)



C57)

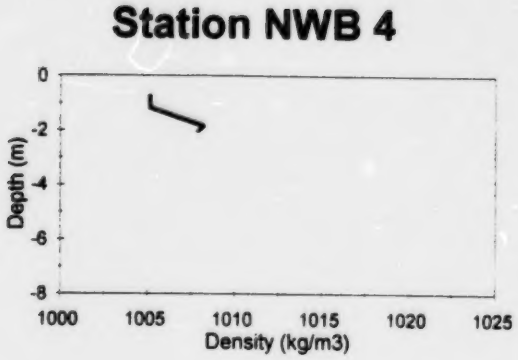


C58)

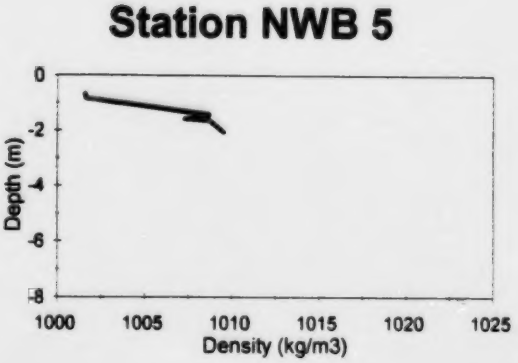


Figures C56, C57 and C58. Density profiles at stations NWB1, NWB2 and NWB3, 24 Oct. 1996.

C59)



C60)



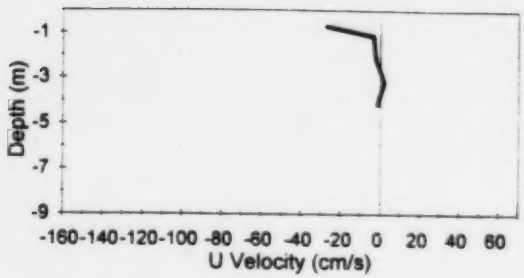
Figures C59 and C60. Density profiles at stations NWB4 and NWB5, 24 Oct. 1996.

APPENDIX D

VELOCITY (U COMPONENT) PROFILES

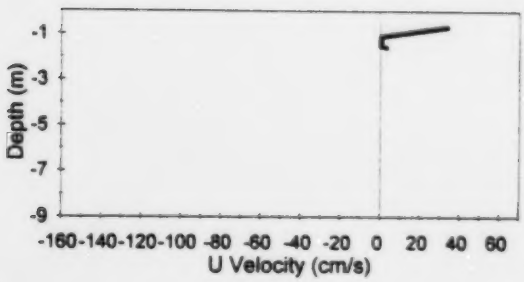
D1)

Station RR 4



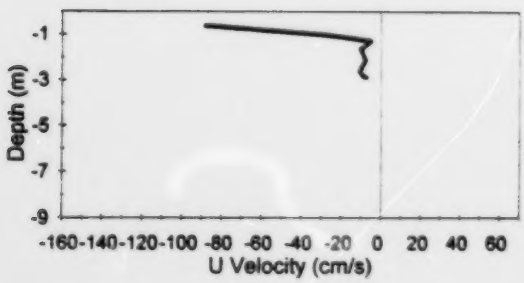
D2)

Station RR 5



D3)

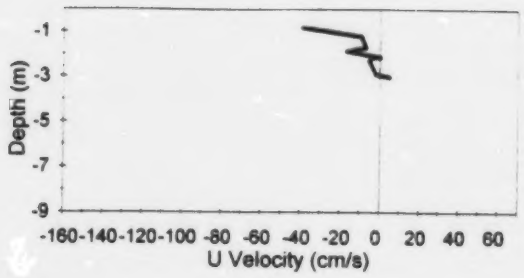
Station RR 6



Figures D1, D2 and D3. U components of current velocity (cm/s) at stations RR4, RR5 and RR6, 9 Sept. 1996.

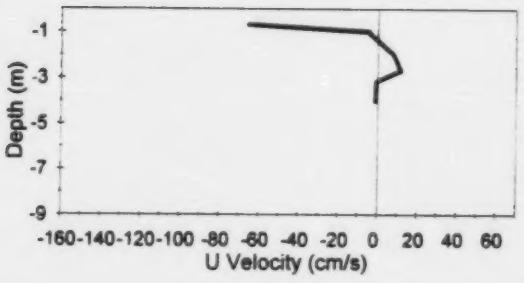
D4)

Station RR 7



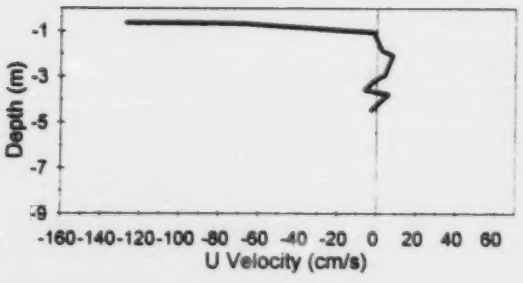
D5)

Station RR 8



D6)

Station RR 9



Figures D4, D5 and D6. U components of current velocity (cm/s) at stations RR7, RR8 and RR9, 9 Sept. 1996.

D7)

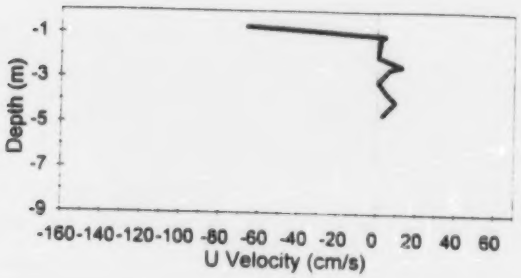
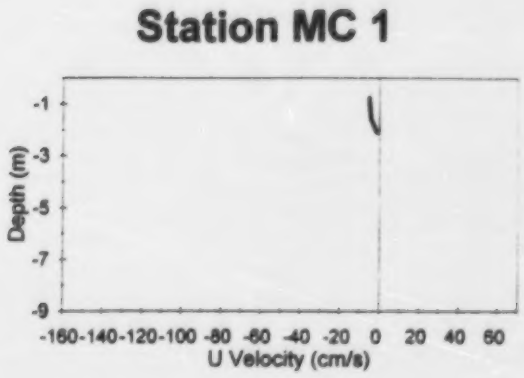
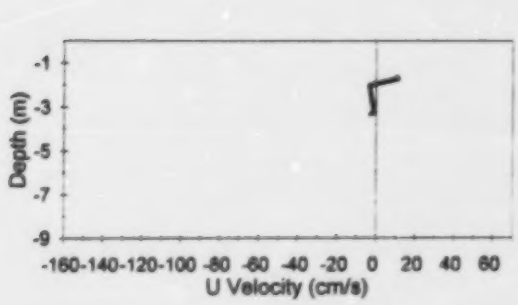


Figure D7. U components of current velocity (cm/s) at station RR10, 9 Sept. 1996.

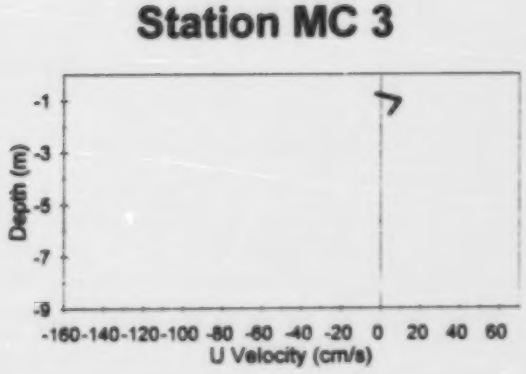
D8)



D9)

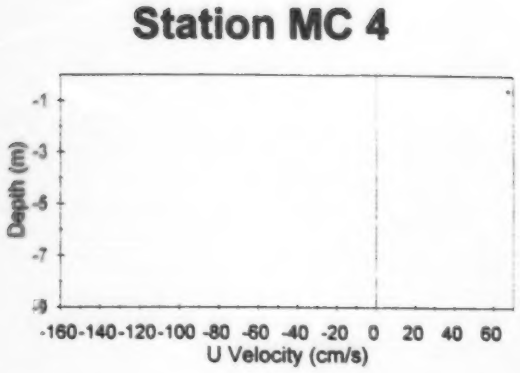


D10)

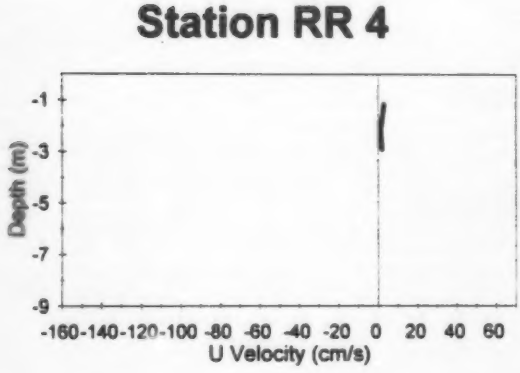


Figures D8, D9 and D10. U components of current velocity (cm/s) at stations MC1, MC2 and MC3, 12 Sept. 1996.

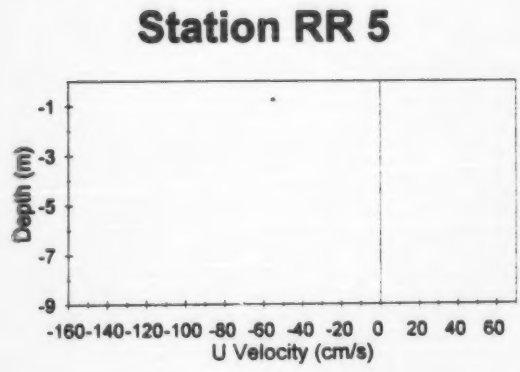
D11)



D12)



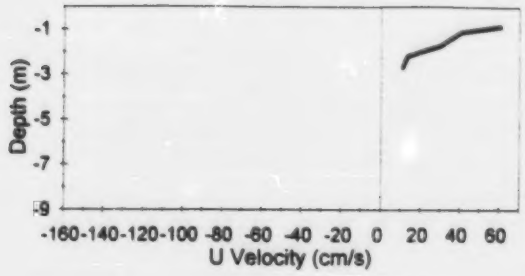
D13)



Figures D11, D12 and D13. U components of current velocity (cm/s) at stations MC4, RR4 and RR5, 12 Sept. 1996.

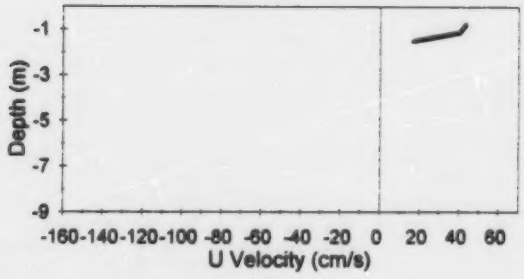
D14)

Station RR 1



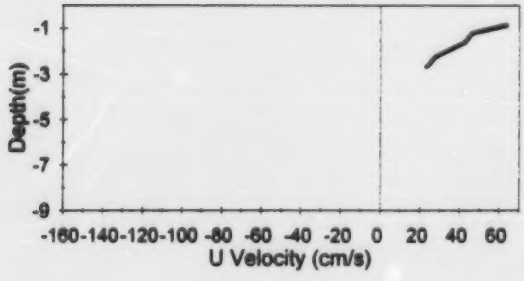
D15)

Station RR 3



D16)

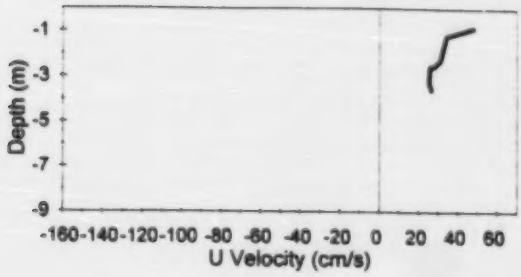
Station RR 4



Figures D14, D15 and D16. U components of current velocity (cm/s) at stations RR1, RR3 and RR4, 18 Sept. 1996.

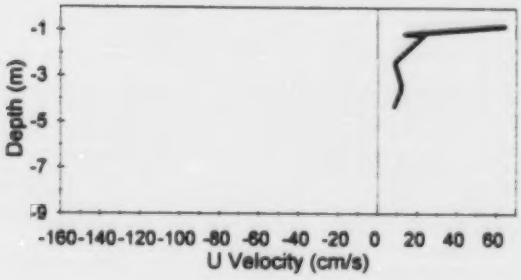
D17)

Station RR 5



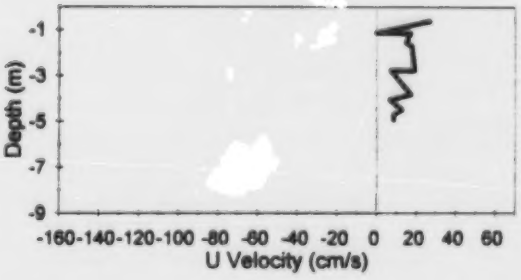
D18)

Station RR 7



D19)

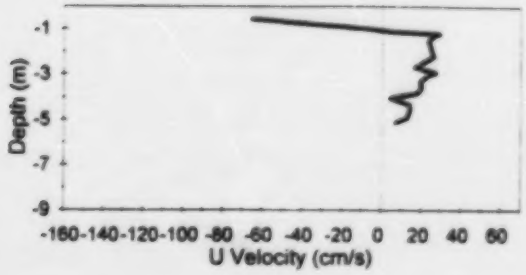
Station RR 10



Figures D17, D18 and D19. U components of current velocity (cm/s) at stations RR5, RR7 and RR10, 16 Sept. 1996.

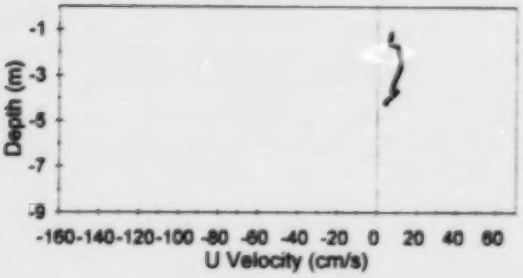
D20)

Station RR 11



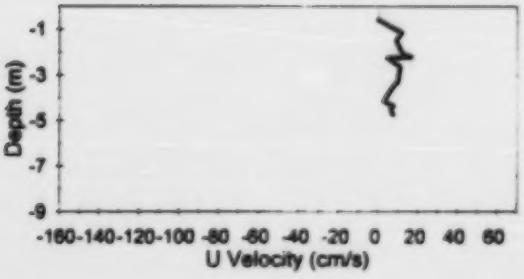
D21)

Station RR 12



D22)

Station RR 14



Figures D20, D21 and D22. U components of current velocity (cm/s) at stations RR11, RR12 and RR14, 16 Sept. 1996.

D23)

Station RR 15

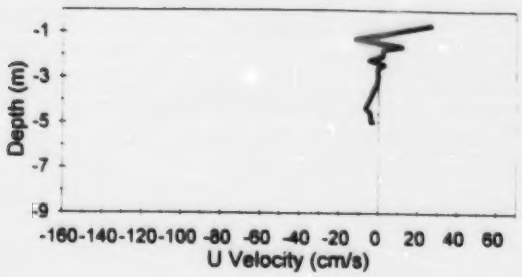
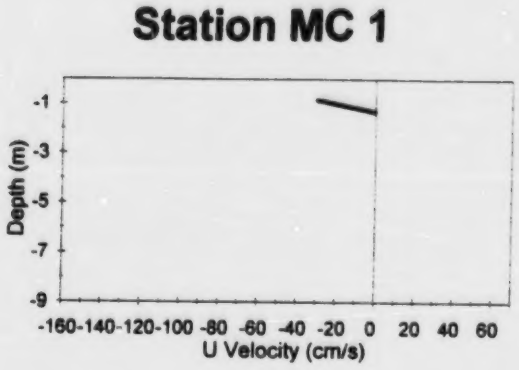
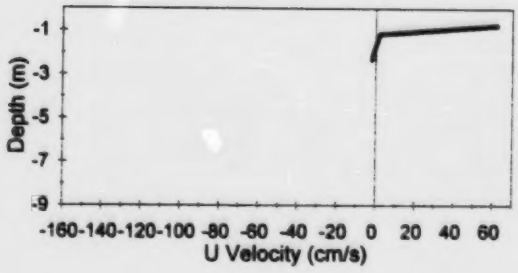


Figure D23. U components of current velocity (cm/s) at station RR15, 16 Sept. 1996.

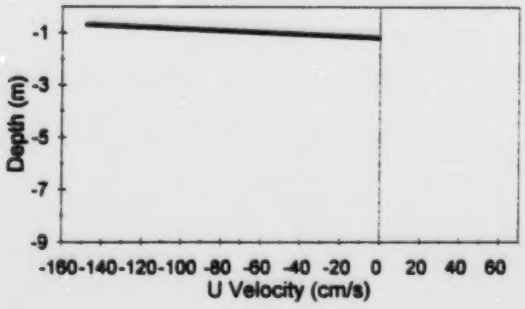
D24)



D25)

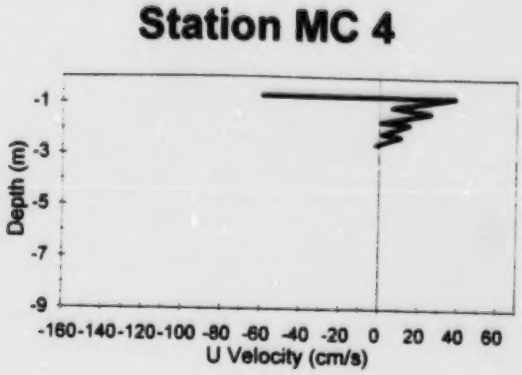


D26)

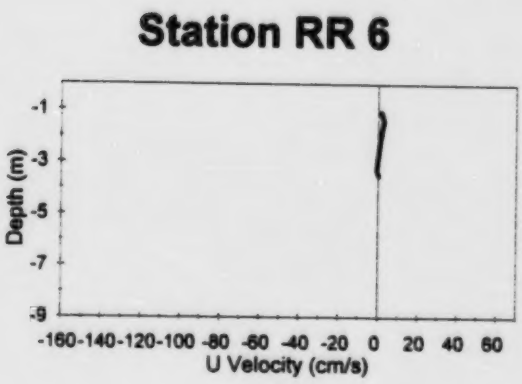


Figures D24, D25 and D26. U components of current velocity (cm/s) at stations MC1, MC2 and MC3, 18 Sept. 1996.

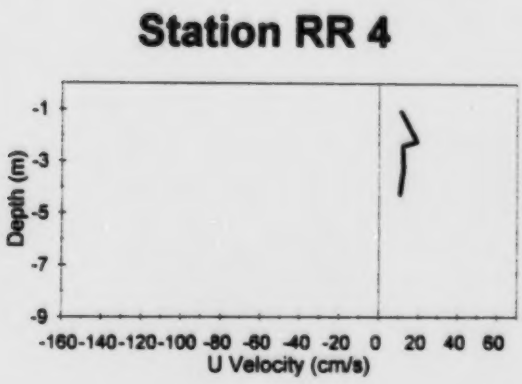
D27)



D28)



D29)



Figures D27, D28 and D29. U components of current velocity (cm/s) at stations MC4, RR6 and RR4, 18 Sept. 1996.

D30)

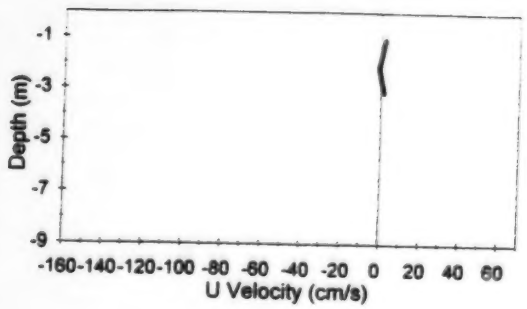
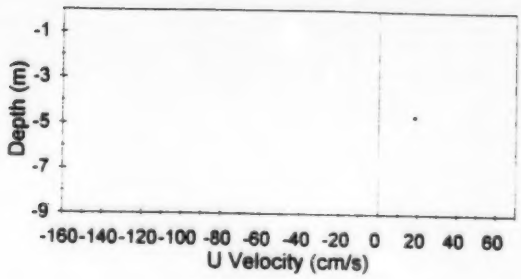


Figure D30. U components of current velocity (cm/s) at stations RR3, 18 Sept. 1996.

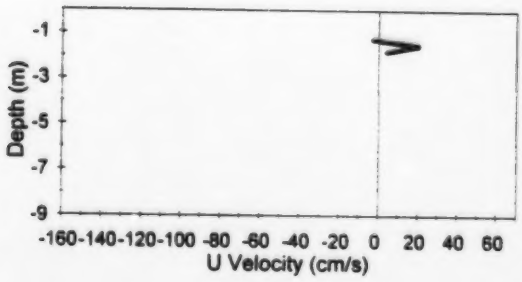
D31)

Station RR 11



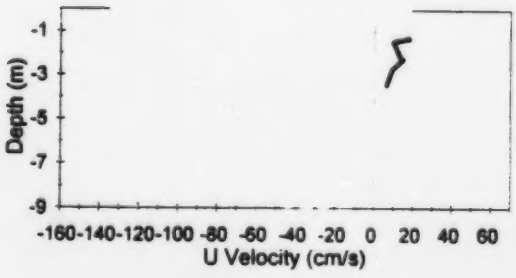
D32)

Station RR 12



D33)

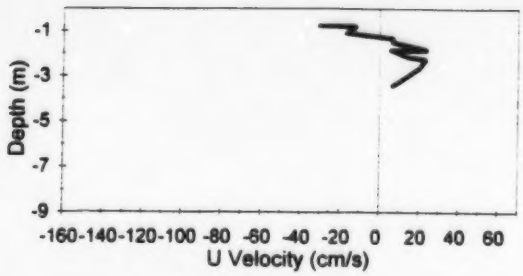
Station RR 13



Figures D31, D32 and D33. U components of current velocity (cm/s) at stations RR11, RR12 and RR13, 18 Oct. 1996.

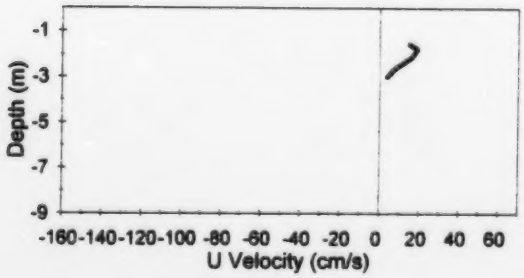
D34)

Station RR 15



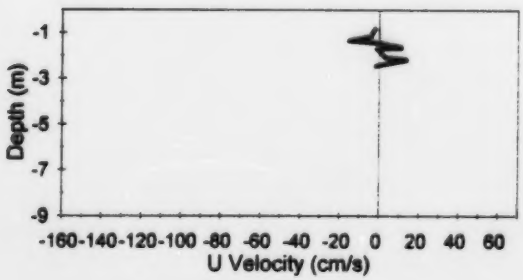
D35)

Station RR 16



D36)

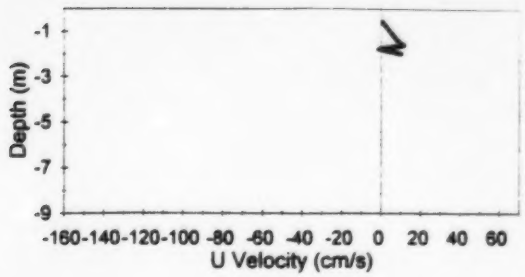
Station RR 17



Figures D34, D35 and D36. U components of current velocity (cm/s) at stations RR15, RR16 and RR17, 18 Oct. 1996.

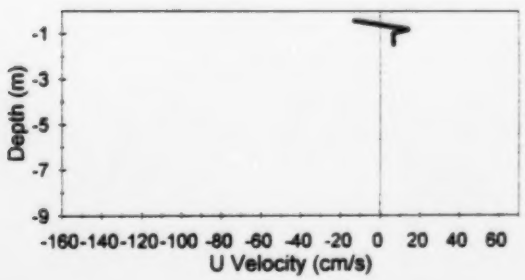
D37)

Station RR 18



D38)

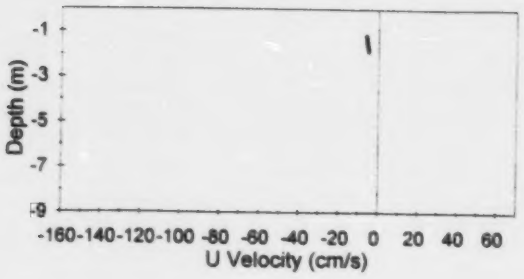
Station RR 19



Figures D37 and D38. U components of current velocity (cm/s) at stations RR18 and RR19, 18 Oct. 1996.

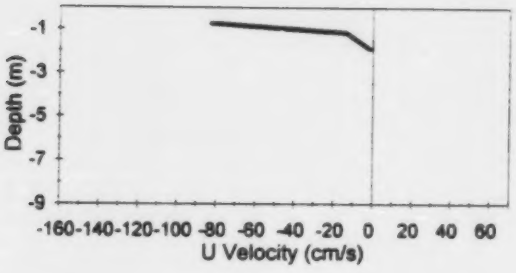
D39)

Station BV 1



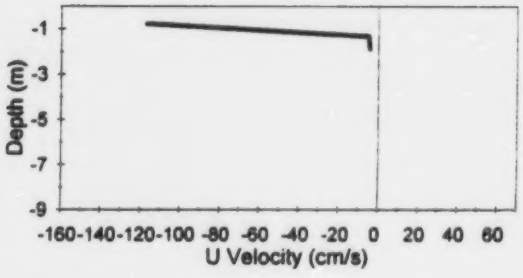
D40)

Station BV 2



D41)

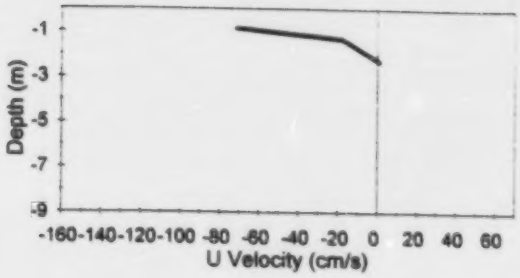
Station BV 3



Figures D39, D40 and D41. U components of current velocity (cm/s) at stations BV1, BV2 and BV3, 21 Oct. 1996.

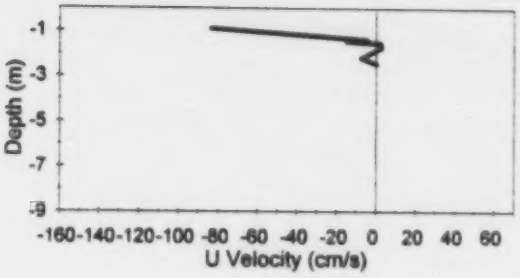
D42)

Station BV 4



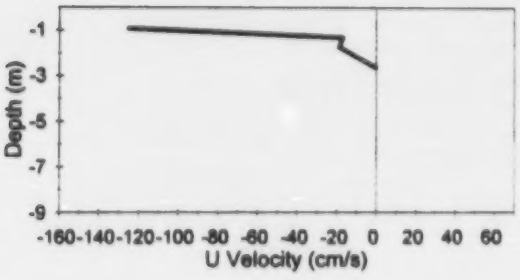
D43)

Station BV 5



D44)

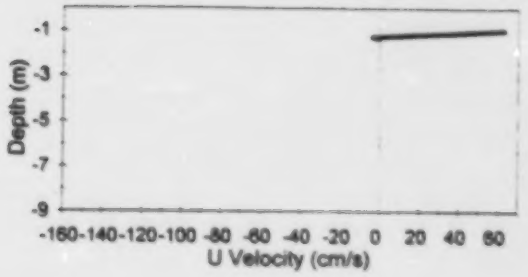
Station BV6



Figures D42, D43 and D44. U components of current velocity (cm/s) at stations BV4, BV5 and BV6, 21 Oct. 1996.

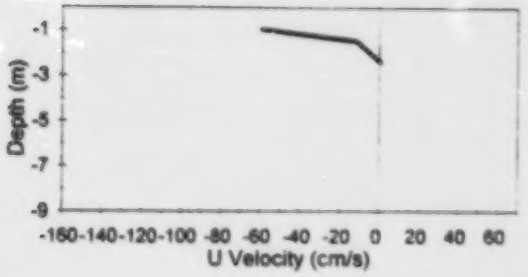
D45)

Station BV 7



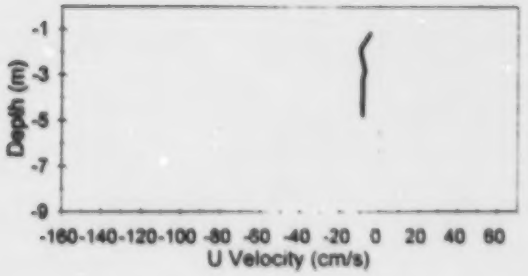
D46)

Station BV 8



D47)

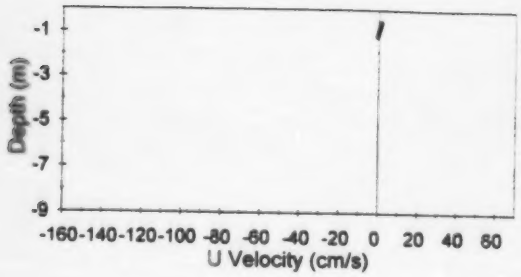
Station BV 9



Figuree D45, D46 and D47. U components of current velocity (cm/s) at stations BV7, BV8 and BV9, 21 Oct. 1996.

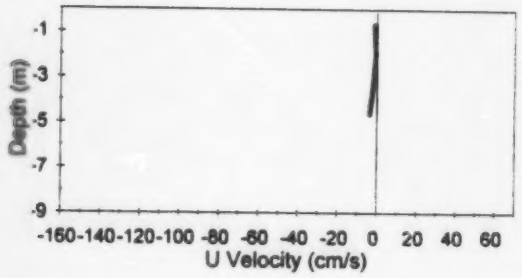
D48)

Station RH 1



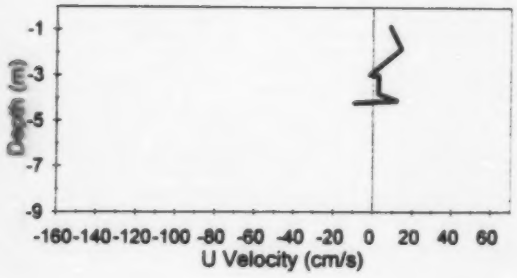
D49)

Station RH 2



D50)

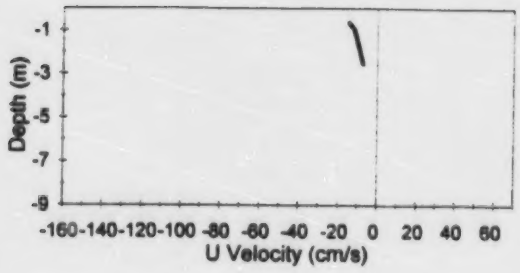
Station RH 3



Figures D48, D49 and D50. U components of current velocity (cm/s) at stations RH1, RH2 and RH3, 24 Oct. 1996.

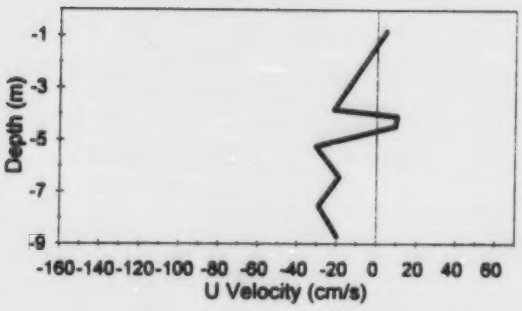
D51)

Station RH 4



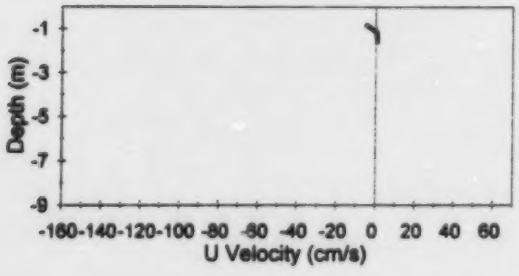
D52)

Station RH 5



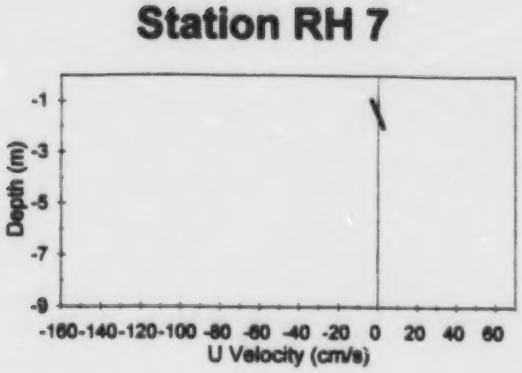
D53)

Station RH 6

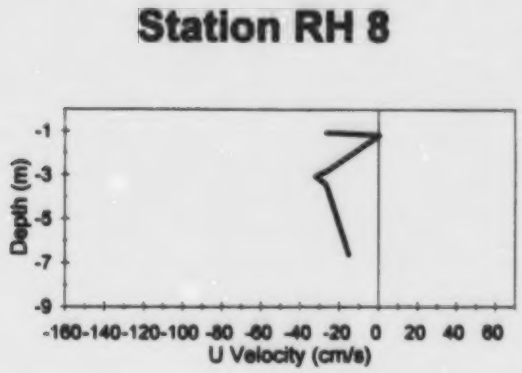


Figures D51, D52 and D53. U components of current velocity (cm/s) at stations RH4, RH5 and RH6, 24 Oct. 1996.

D54)

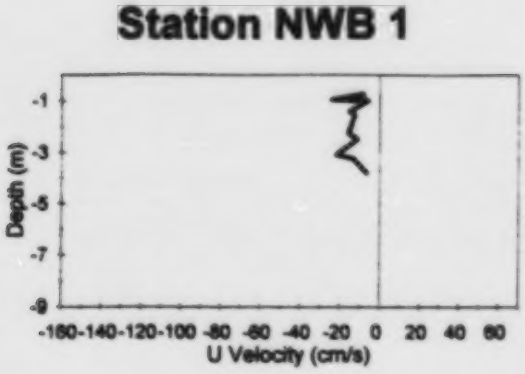


D55)

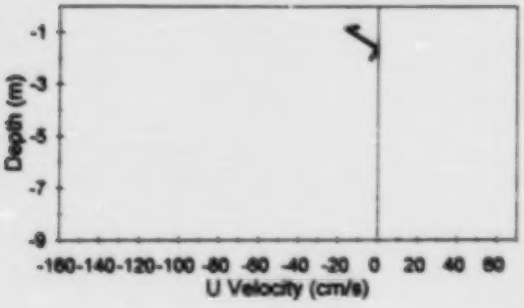


Figures D54 and D55. U components of current velocity (cm/s) at stations RH7 and RH8, 24 Oct. 1996.

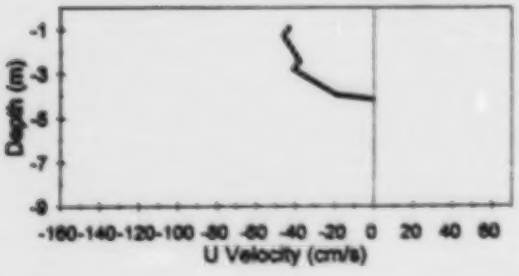
D56)



D57)

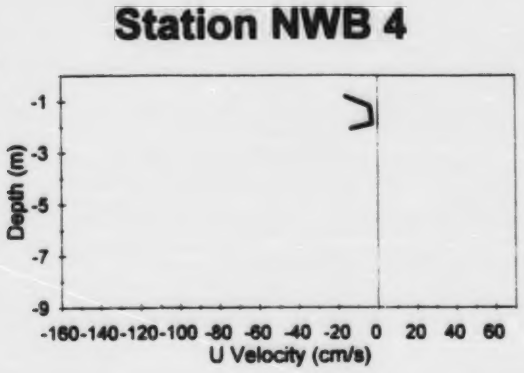


D58)

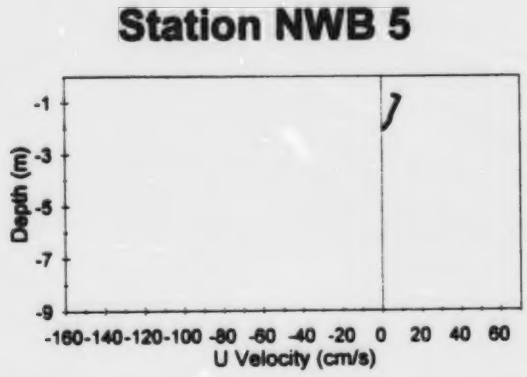


Figures D56, D57 and D58. U components of current velocity (cm/s) at stations NWB1, NWB2 and NWB3, 24 Oct. 1996.

D59)



D60)



Figures D59 and D60. U components of current velocity (cm/s) at stations NWB4 and NWB5, 24 Oct. 1996.